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SCIENCE MEETINGS IN WAR-TIME

WAR conditions, though they may make unprecedented demands on our scientific knowledge and technical skill, throw us, in some of their aspects, back to simpler ways of living and to the use of more primitive appliances. The horse has come into his own again; venerable carriages, bearers of long-forgotten names—who, in this twentieth century generation, can readily distinguish between barouche, victoria, cabriolet and whisky?—appear in provincial streets and country roads, astonishing all but the oldest inhabitants; and we find new merits in the performances of (duly-shaded) hurricane lamps and wax candles. A railway journey, prolonged after sunset, adds a new terror to life for those of us who are not content to sit and think. We look back with something of envy to those spacious days when our grandparents travelled luxuriously and read in comfort by the light of some candle-bearing contraption which could be hooked to the back of a railway-carriage seat. Meetings, even in neutral nd reception areas, are not to be attended without due consideration of the perils associated with a journey through 'blacked-out' streets.

Nevertheless, it is a matter of no small importance that our scientific societies, restricted and re-orientated as some of their activities necessarily must be, should carry on their work to the fullest extent possible under these new conditions of life. A hasty and ill-considered cutting-down of work brings many evils in its train. Fellows tend to forget the existence of the society, and its membership roll falls off in consequence; the economic life of certain sections of the community suffers unnecessary and undeserved hardships; the world at large fails to realize that a scientific society can play as weighty a part in war as in peace. It was never more important than it is now to conserve and to extend our mental resources; to meet and to exchange ideas; to cultivate a sane and objective outlook on the problems of a world poised insecurely on the brink of chaos.

Travel is difficult; so it was two centuries ago, and provincial towns formed, each for itself, societies for the advancement of learning. Members are scattered; and does not this very fact ensure the presence, in most of our large towns to-day, of men and women sufficiently interested in their different branches of knowledge to welcome an opportunity to exchange views and to seize an hour for the friendly discussion of intellectual problems? Cinemas may be filled to-day—and it is all to the good that they should be—even in evacuation areas; there is little room to doubt that, if the opportunity be given them, scores of scientific workers would welcome the chance to discuss the ever-changing problems of their sciences, and to find, now and again, a period of their day which would be free from the problems of war.

The past has its lessons for the present; material conditions for travel and for social intercourse were more difficult in 1770 than they are now, and we find in consequence that the greater cities of Britain tended each to cultivate a social life of its own, a social life that was dominated, in many instances, by the bearers of names now honoured in our country's history. The intellectual standard of our university towns in that age has not passed uncriticized. Gibbon has told us of Oxford; Byron, at a slightly later period, had some unkind things to say of the Cambridge fellows:

> "Where on Cam's sedgy banks supine they lie,
> Unknown, unhonoured live, unwept-for die:
> Vain as their honours, heavy as their ale,
> Sad as their wit, and tedious as their tale";

Johnson made shrewd thrusts at Scottish learning. But these are partisan views, and an impartial observer will find that the contributions of the university towns of that age to the advancement of learning and to the critical discussion of those advances were by no means unsubstantial. Other towns, as we have noted, made their contribution mainly through one or two families of dominating interests. The Taylors and Martineaus made such a group at Norwich; the Roscoes at Liverpool; and at Birmingham above all, Boulton, Watt, Small, Erasmus Darwin, Priestley and Wedgwood formed a group whose contributions to knowledge were a considerable factor in the development of eighteenth century science.

This group had, as early as the 1760's, formed the excellent habit of dining at each other's houses monthly "to exchange views relating to literature, art and science; each contributing his quota of entertainment and instruction". For the convenience of the members the meeting nights were fixed for evenings as near to that of the full moon as possible. Art had not then provided an effective means for lightening the darkness of the streets and lanes; why not make use of the illumination provided by Nature?

It is no part of our purpose to tell in detail the fortunes of the Lunar Society as it was happily named—it is sufficient to say that many discoveries of the first importance were discussed at its meetings before they were communicated in regular fashion to the Royal and to other societies; that the "learned Lunatics", as Erasmus Darwin styled his fellow-members, helped to finance much of Priestley's work; and that even when the Society, by death and dispersal, had lost most of its members and was moribund, Leonard Horner could say of it, in 1809, that "the remnant of the Lunar Society and the fresh remembrance in others of the remarkable men who composed it, are very interesting. The impression which they made is not yet worn out, but shows itself, to the second and third generation, in a spirit of scientific curiosity and free inquiry which even yet makes some stand against the combined forces of Methodism, Toryism and love of gain."

The spirit of free inquiry has to-day to encounter forces other than those which excited the concern of Horner, and the learned societies of the democratic countries—indeed, of all countries—may even to-day learn something from the zeal and unselfishness which informed the work of the Lunar Society. In one small matter they might very well profit by the return to some of the conditions of life as it was lived in the days of Erasmus Darwin, and hold meetings on nights near the date of the full moon. If secretaries of the learned societies of London were to consult their almanacs and maps of Britain, they would surely find times and places favourable for the holding of informal meetings suited to present-day needs, as the Linnean Society is already doing (see page 778); and the Lunar Society would enter on a new lease of life.

NATURAL AND POLITICAL PHILOSOPHIES

Science and Politics in the Ancient World

By Prof. Benjamin Farrington. Pp. 244. (London: George Allen and Unwin, Ltd., 1939.) 10*s.* 6*d.* net.

IN Plato's City-State, the ruler or lawgivers were held to be justified in inventing or approving useful or pious lies if the best minds were convinced that the community was incapable of understanding the truth. The State had to decide what was good for the people to know and accept, whether relating to governmental legislation or religious beliefs. The right appreciation of truth was regarded as the prerogative of a select few and, as popular intelligence was not prepared for enlightenment, it was inexpedient to teach the masses anything which would disturb either their social complacency or superstitions. Socrates himself, to whom many of the political principles represented in Plato's "Republic" can be ascribed, was condemned to die because he would not cease to "corrupt the young" by his teaching; and Galileo might have saved himself from imprisonment by ceasing to disturb the traditional teaching of the Church as to the stability of the earth in the centre of the universe.

It is with repercussions of this kind in the ancient worlds of Greece and Rome that Prof. Farrington is concerned in his critical survey of philosophies of science in relation to political action from the period of Thales and Anaximander in the sixth century B.C., through Empedocles, Leucippus and Democritus, creators of theories of atomism, which, with Hippocratic medicine, are

the two great achievements of pre-Socratic science, to Plato, Epicurus, Lucretius and some theological philosophers of the Christian era. Beginning with appreciative references to the brilliant work of the early philosophers of the Ionian school, who may be said to have founded physical science, Prof. Farrington traces the decline of the spirit of inquiry into the nature of things and attributes it largely to the influence of Platonism. They made few actual experiments, but they understood the difference between theory based upon observations of natural phenomena and metaphysical speculations. Had their spirit not been suppressed because it was not believed to be expedient to politics or religion that the people should partake of the new knowledge, there is no doubt that, within the limits of observation available, experimental philosophy would have made great advances in the ancient world.

The view of the Governments and leaders of thought in the class-divided societies of classical antiquity was that the mass of the people should be guided only with knowledge which was considered to be "wholesome" for the good of the State, and that it was therefore permissible to maintain control through the use of the "Golden lie". There are many to-day who see in modern science nothing but a disturbing influence which threatens the destruction of all that is worth preserving in civilized life, and regret that its progress has not been strictly impeded. The purpose of suppression of ideas in the ancient world was to secure the stability of a slave State; and the social problems raised by the increase of power by machines and in weapons of war had not arisen. Whatever the consequences, Prof. Farrington maintains that, with the actual progress of knowledge, modern society is unworkable without a wide understanding of the results. He remarks:

"These considerations reveal to us the further fact that there is a connection between the character of science and its dissemination. In this matter our democracies are at the cross-roads. Either our science must transform itself by the recognition that the history of its development is unintelligible without an understanding of its social origin, that men cannot be adequately trained in applied science without instruction in its social functions; and that the obstacles to the progress of science can be external to it, in the sense that they rise out of the structure of society as well as out of theoretical errors; either this transformation must take place or science must retreat. The future of science is now plainly a political question. Either we must base our civilization more thoroughly on scientific foundations, or we must destroy science itself. Both processes are taking place in the world to-day."

Nearly one half of Prof. Farrington's book is devoted to the social and political, as well as the scientific, implications of the works of the two great classical writers, Epicurus and Lucretius, who carried on the traditions of Ionian natural philosophy, and helped to free the minds of men from the fetters of superstition. In his support of the Ionian tradition, and his advocacy of popular enlightenment, Epicurus was fundamentally opposed to the philosophy of Plato. He identified philosophy with a knowledge of Nature, and laid emphasis on sense evidence as the criterion of truth. It was Epicurus who endowed the atom with an element of spontaneity of movement, or "swerve", and he connected this with the idea of the freedom of will in man. He did not invent the theory of atomism, with the precise development of which the name of Democritus, who lived a century earlier, is now rightly associated, but to him must be ascribed the introduction of the element of intrinsic movement, as, for example, in the jump of an electron from one orbit to another, which modern atomic theory has to take into account.

The opposition to Epicurus and his disciples did not arise from these scientific aspects of atomism, but from teaching which would deprive religion of its value as an instrument of political domination. To the Epicurean, the history of man and civilization was part of the natural history of the universe; and it was the specific originality of Epicurus to have defended freedom of the will in man as a product of evolution. Lucretius presented this philosophy with passionate intensity in his "De Rerum Natura". His poem was a protest against the use of superstitious beliefs for political authority and a plea for the rational study of natural events and phenomena. It represented "the last great cry of Greek science, expressing not only its devotion to truth but its devotion to humanity"; and because it was as contrary to the political system of the rulers of Rome as it was unacceptable to the oligarchies of earlier Greece, the Epicurean philosophers were expelled by the Roman Senate in the year 173 B.C. With the birth of Christianity, another element for the regeneration of ancient society came into existence, but physical science had no place in it, and suppression of all knowledge of Nature except that derived from the Hebrew Scriptures prevailed for a thousand years.

Prof. Farrington's scholarly and original survey of the reactions between natural science, religious beliefs and political power is of particular interest at the present time when civilization is in the melting-pot, with these three elements as the main constituents of a compound which, whatever its nature, will have a determining influence upon

human evolution for many generations. The social relationships which he submits to critical analysis are those of City-States, but the crucible into which they have now been thrown is that of the world, and all who believe in truth and righteousness as standards of value should contribute whatever is within their power to make the fiery process through which we are now passing a means of constructing a world organization of society worthy of the intelligence of twentieth century civilization.

R. A. Gregory.

ANIMAL PHYSIOLOGY

An Introduction to Animal Physiology

By W. B. Yapp. Pp. xv + 320 + 4 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1939.) 8*s*. 6*d*. net.

THE quotation from "Through the Looking Glass" which precedes the text of this book gives the clue to its contents.

> "Come, tell me how you live," I cried,
> "And what it is you do."

The author, assuming a knowledge of animal morphology and organic chemistry on the part of the reader, uses these as the basis for the more mechanistic side of comparative physiology, and this in its turn serves to explain the working of the animal body as a whole, its reactions to the outside world, the co-ordination of its vital processes, and its adjustments to the environment in so far as these can be considered from a mechanistic point of view. There are chapters on nutrition, excretion, respiration, effector systems and reproduction, dealing with the working of isolated tissues and organs, and on co-ordination, behaviour and regulation, describing the reactions of the animal as an individual. Each chapter is subdivided on the lines of the Dewey system, so that a subject can be traced either from the index or from the table of contents. This is important, since one chapter may range over the whole animal kingdom and all parts of the animal body. Thus Chapter iv, the effector systems, contains an account of the working of cilia and flagella, pseudopodia, muscles, glands, electric organs, luminescent organs, nematocysts and chromatophores.

All who are concerned with zoological work will welcome the appearance of this book. There is no doubt that it will satisfy a need, both in the schools where biology is taught and in the universities. Its subject-matter is sound and well chosen, and the author has made careful use of the current literature. It is a thoroughly competent piece of work. The criticisms which follow are mostly of a minor character and in no way minimize the value of the book as a whole.

So much material has been incorporated into the book that much of it might consist of lecture notes, and it lacks the literary style that makes a book readable. The first chapter suffers most from this defect, but in later chapters there is considerable improvement, as though the author had got into his stride. The subject-matter in the chapter on nutrition is illogically arranged and sometimes obscurely expressed. For example, the *physical* side of the process of digestion is neglected until the whole of the *chemical* reactions have been dealt with, and after the digestion of proteins, fats and carbohydrates has been described, and the digested matter has been absorbed through the walls of the villi, the reader comes to a section which begins, "In man and many other mammals the food in the mouth is masticated". Since this physical breakdown of the food is preparatory to any chemical action, why should not this section (1.315) have preceded the other? Moreover, by placing it first, the reader is reminded of the course of the alimentary canal as a whole, and is better prepared to understand the chemical section, where morphological sequence cannot be followed.

Some of the statements are misleading. "In man about a litre of saliva is produced a day. It contains a protein called mucin, and its chief value is to act as a lubricant". There is no mention of ptyalin in this section (1.31) although the enzymes of the stomach are recorded. Again, "One . . . is called a male or a spermatozoon, and the other . . . a female or an ovum" (p. 252). "The vertebrate kidney . . . eliminates water, nitrogen and many other substances". Such sentences require a more accurate presentation of the facts.

So much subject-matter has been utilized that one hesitates to name omissions. But since most university students dissect the nerves supplying the taste buds of the teleost fish, the brief statement on p. 209 might be expanded, and Herrick's paper on the gustatory organs of fishes added to the list of references. The inferiority of the sense of smell in man (p. 211) is both physiological and morphological, yet no use is made of the latter contribution, although sniffing in order to lift the odorous particles above the naso- and

maxillo-turbinals (innervated by the trigeminal nerve) to the pocket in which lie the ethmo-turbinals (innervated by the olfactory nerve) is an adaptation which explains the statement that the sense of smell in man is very poor compared with that in dogs and many other animals. Graham's paper on the crystalline style (*Proc. Zool. Soc.*, 109, 1; 1939) probably appeared too late for inclusion, but why is Russell's work on behaviour not mentioned? Also Parson's "Biochemistry" is an almost indispensable companion volume.

The book has been well produced by the Oxford University Press and there are few misprints. Schäfer's name is wrongly spelt on both occasions when it is mentioned, *inhalant* should be replaced by *exhalant* on p. 9, line 17, and Henle has no accent on the final e. There are four plates and forty text-figures, most of which are copied from other authors. Figs. 4 and 40 are poor and inaccurate.

On the whole, however, the book is an admirable effort in a new and rapidly expanding field of biology. We hope the author will now produce a volume of practical exercises in animal physiology.

RACE QUESTIONS IN EUROPE

(1) The Races of Europe
By Prof. Carleton Stevens Coon. Pp. xvi + 739 + 46 plates. (New York: The Macmillan Company, 1939.) 31*s.* 6*d.* net.

(2) The Races of Central Europe
A Footnote to History. By Dr. G. M. Morant. Pp. 164. (London: George Allen and Unwin, Ltd., 1939.) 5*s.* net.

(1) IN 1899 W. Z. Ripley produced his classic work on "Races of Europe" and the appearance of a book prepared at his suggestion to bring matters up to date is of considerable importance, especially in these days when race-study is suffering so severely from political perversions. Coon has read very widely and tries to bring together data from archæology and physical anthropology; his syntheses are often bold but always suggestive, and he indicates in several places that evidence on particular points is specially defective.

Coon's broad conclusion is that the present-day biological types in Europe are derived from: (1) a basic *Homo sapiens* related to the remote ancestors of the Mediterranean types; (2) a blend of (1) with some *non-sapiens* form of general Neanderthaloid form; (3) various blends of (1) and (2), all being present and widely distributed in Europe while collecting, hunting and fishing were still the only means of getting food; (4) peoples from Asia and North Africa of Mediterranean types who introduced the arts of food production.

To Group 1 the author considers we should ascribe the Galley Hill skull which he accepts as Middle Pleistocene, the so-called Negroids of Grimaldi, and the male skeleton from the Upper Palæolithic of Combe Capelle, France. They are short, long- and very narrow-headed with a high cranial vault, moderate cheek bones and lower jaws, fairly wide nose and little projection of the mouth. To Group 2 he ascribes the Cro Magnon man and the Solutré skulls among western and west central European types and notes the tallness, the greater width of the head than in Group 1 and the very broad facial development with low orbits and narrow noses. The east-central European variety is again tall and bony but is extremely long-headed like Group 1.

Once he had adapted himself to the cold, in the second phase of the Würm glaciation, man followed the retreat of the ice northwards and there thus came into existence the basic elements of population in north-west Europe, the east-central variety of Group 2 being increasingly important. Coon looks upon the west-central variety of Group 2 as the root stock of later central European broadheads, but thinks there may be factors other than Mendelian dominance connected with the remarkable spread of broadheadedness, now almost universal in central Europe; the mean cephalic indexes he gives for different parts of Germany range from 80 to 85.

Coon notes the zoning of pigmentation from blondness in the north-west to predominant dark colouring of head and eyes in the south and south-east. For him, as for most unprejudiced students, there is not a blond long-headed tall type distinct from the beginning of the story. The spread of the arts of food production and of settled life he sees as an accompaniment of the advance of the Mediterranean types into Europe, sometimes handing on their knowledge to descendants of the varieties of Group 2. He thinks the early Danubian peasantry were of Mediterranean type and that the people who made corded pottery, and were of the east-central variety of Group 2, blended with survivors of Palæolithic men who had followed the retreating ice, and that this mixture, with loss of pigmentation, became what is known as the Nordic group. But this summarizes his account too severely, and students should read

his pages, realizing, as he does, that his synthesis may well be modified very greatly as knowledge grows. The one thing that appears ever more clearly is that civilization did not originate in the Germanic – West Baltic area as some have tried to argue.

Coon looks upon the Lapps as to some extent early European broadheads related to the west-central variety of Group 2, modified by immigrants from Asia along the north. Another interesting hypothesis is that the people with flat-backed high broad heads, commonly called Dinaric, are the result of a blend between a tall variety of the Mediterranean group and the early broad-heads of Central Europe. He shows that Alpine or Central European, as well as north-west European elements, have entered to a large extent into the composition of the modern Jewish groups, which vary greatly from place to place and in any one place include very diverse individuals. The basis, like that of the European population, is Mediterranean. One welcomes the wisdom of the author in avoiding assertions about racial superiority or inferiority and in insisting on the importance of past blending and intermixture in the racial history of Europe.

In a second edition one hopes the author will include some discussion of the Milankovitch chronology, will perhaps be a little more critical here and there on the physiological side, will clear up a few expressions and printer's errors and slips of memory such as one on p. 375 which mixes refugees after the revocation of the Edict of Nantes (1685) with those who fled from the atrocities of the Duke of Alva (1567–73), and penslips such as one on p. 372 which says the Irish Goidels invaded Scotland from the east.

The fifty plates, mostly with twelve photographs on each, usually giving full face, profile and semi-profile views of persons whose measurements are also given, set a high standard, especially as explanatory text accompanies the photographs and often summarizes clearly the arguments in the body of the book.

(2) Dr. G. Morant's little study of "The Races of Central Europe" is essentially a tract for the times and is a careful exposition of his point of view backed by a mass of information concerning details, and very ably put together. Dr. Morant represents the older biometric school of anthropologists which holds that it is best to deal with samples of populations as units and to describe them by means of average values for the different physical characters; those who feel the weakness of this mode of approach are anxious to pay their tribute to the ability and sincerity of Dr. Morant's work.

Both Coon and Morant in their diverse ways emphasize that greater differences can be found between German-speaking groups in Central Europe than those between certain German and certain non-German peoples, and Morant has worked this out for blood-agglutination figures as well. The proportion of *O* and the ratio of *A* to *B* vary together to a large extent, a high proportion of *O* being accompanied by a high ratio of *A* to B. Both these figures are far higher for samples from the pre-Munich Germany than for samples from lands to the east. East Prussian, Silesian and Austrian samples are characteristically intermediate between the non-strictly German ones and those for Polish, Czech, Slovak, Magyar or Rumanian areas, while such information as we have for Russia shows still smaller values for *O* and for *A*/*B*.

Morant considers that in the *Völkerwanderungszeit*, the German peoples were longheaded (indexes 72–76), that in the Merovingian time there was a great infiltration of broad heads (indexes above 80) in two main waves. These two waves completely swamped the earlier type which disappeared. There is a considerable measure of truth in this statement, but it is well to remember, as Morant does, that the number of skulls available is not large and may represent a selected, perhaps an aristocratic, group. Morant emphasizes that, for Central Europe, cephalic index, colouring and stature are less important criteria than blood agglutination groups, and the latter have the advantage that they appear to remain constant throughout life, while samples of males and females respectively in the same district correspond closely. Also, here we have to do with distinctive characters, not with measurements and ratios that shade into one another.

Concerning utilization of averages and the difficulties involved, we note that Morant gives (Fig. 3) the marking to Bohemia and Moravia that indicates an average stature of 168–170 cm., as against 166–168 cm. in Bavaria and Austria, etc., and 164–166 cm. in Germany. Coon, on the other hand, gives 167 cm. as the average Czech stature. Differences of sample can affect the result and in this case the acceptance of Coon's figure would put the Czechs into the same grade as the Austrians and Bavarians. Quite possibly Morant's statement is nearer the truth, but averages are of doubtful value.

Morant is clear that race cannot be used to rearrange the political map of Europe and that racialism as between Europeans is rubbish. All his fellow-workers will subscribe to this conclusion, whatever reserves—and they are many—they have about his utilization of Pearson's coefficient of racial likeness. He sees that it is only a rough instrument of analysis; many others feel it has led to such errors as should put it out of court.

THE ELECTRIC DISCHARGE IN ENGINEERING SCIENCE

Gaseous Electrical Conductors

By Prof. E. L. E. Wheatcroft. (Oxford Engineering Science Series.) Pp. xi+265+6 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1938.) 21*s.* net.

THE earliest industrial applications of the phenomena associated with strongly ionized gases, or 'gaseous conductors', appear to have been the introduction in England of the carbon arc for illumination in the early eighties, followed shortly by Moore's nitrogen and carbon dioxide discharge tubes in America. In the beginning of the twentieth century, electric discharges first began to be used on a considerable scale in chemical engineering, notably for the production of ozone in connexion with air and water purification, of nitric acid from the air, and of lubricants by the polymerization of light oils; about the same time discharges were also applied to the precipitation of dust and mist, and to the generation of high-frequency currents for radio communication. The phenomena associated with 'free' electrons in high vacua have been applied in the development of the present rich variety of X-ray tubes, wireless valves, and cathode ray tubes. The development of the transmission of electric energy has brought to light the importance of discharge phenomena in relation to the design of high-tension cables, insulators, condensers, and switchgear; and the physics and chemistry of the ionosphere are directly related to many problems of radio communication. Not the least important is the ignition system of all petrol-fed internal combustion engines, which depends on a gaseous electric discharge.

The comprehensive title, and the preface of Prof. Wheatcroft's book, which is the latest addition to a distinguished series, lead the reader to expect it to be the first English book dealing with gaseous discharge phenomena in relation to the rapidly growing applications in many branches of engineering; the author explains that his aim in expanding his lectures to undergraduates is to produce a book that will be useful to those who "embark upon research in this very interesting and important field". The book is in two parts: the first deals with the physical background; the second relates to applications, but of these the only ones considered are thermionic valves ('hard' and 'soft'), the mercury arc rectifier, circuit breakers, and discharge tubes as illuminants.

In giving the physical background in Part 1, the emphasis has not been fairly divided between 'pure' electron gas as a conductor, and electron gas admixed with ion and neutral molecular or atomic gas, the former being allotted much the greater space; and a whole chapter is devoted to electrons *in* metals. For example, the motion of electrons in a 'dense' gas is dismissed in three pages with a few equations and without any reference to the experimental data of Townsend and others; the result is that the uninitiated reader would gain a totally false sense of simplicity and never realize the essential complexity of the phenomena. Townsend's coefficient of ionization is needlessly and erroneously renamed "the ionization constant α". Also, there is no point in giving Townsend's early theory of this coefficient without indicating the unjustifiable assumptions now known to be involved in it, or to offer an alternative makeshift theory without referring to the detailed analyses of the problem which have been given both for atomic and molecular gases.

Part 2 opens with a long chapter on "Vacuum Electron Valves", which, however, contains much that is irrelevant to this book; for example, the discussion of high-vacuum valve design. The three following chapters on gas-filled valves, the mercury arc rectifier, and circuit breakers, are good, profusely illustrated, and bespeak an intimate acquaintance with these applications. It is this part of the book that the reader who seeks succinct but adequate information will find most useful. The last chapter, on luminous discharge tubes, is startingly inadequate to a branch of gas discharge engineering which is of ever-increasing importance.

The attempt to introduce further complication and changes of convention in the nomenclature for units is to be deplored; for example, the electromagnetic unit of potential is termed the 'centimicrovolt', and engineers have long since decided that the microfarad is a more convenient and practical unit than the farad.

The presentation of the material in this book reflects too often those digressions which are illuminating in a lecture but distracting in a book. Despite the collation of much useful information, and the beautiful production to which we are accustomed from the Oxford University Press, the book falls short of the high standard set by the rest of the series. Nevertheless, for the reader who is willing to spend the time disentangling the information he requires (the joint author-subject index is too brief to be very helpful), there is much in this book which is worthy of attention.

L. S. Harley.
R. Winstanley Lunt.

THE PROBLEM OF PAIN

By Prof. P. T. Herring,
University of St. Andrews

At the Dundee meeting last September of the British Association, Section I (Physiology) paid a visit to St. Andrews, where a discussion was held in the Physiology Department of the University on the problem of pain.

The physiology of pain, interesting and important though it is, is still unsolved. Pain must be regarded as a physiological sensation of a protective character; but like many other physiological phenomena it can become pathological, and the boundary between the two is indefinable. We have no means of determining the intensity of pain, and the psychological element is often an important factor. Many different kinds of pain are described, some of which are due to the admixture of other sensations in consciousness.

For the production of sensation certain anatomical structures are essential—receptors, afferent nerve fibres and a nerve centre or centres which translate the impulses into a conscious sensation. Not all the receptors capable of receiving pain-producing stimuli are known; but the more highly specialized nerve endings can be dismissed, for modern work has shown that they are adapted to specific stimuli only. The cornea of the eye provides an example of a structure which is supposed to be capable of receiving no other sensation than that of pain, and in the cornea the nerve endings are naked axis cylinder terminations intimately associated with the epithelial cells which cover it. The receptors in the epidermis of the skin are believed to be of the same nature, but lying more deeply placed in the living epithelium. In the connective tissues of the true skin there are also many endings of the same kind. The skin is the protective covering of the body, and any form of stimulus which injures it is an adequate one for the production of pain.

There is a pattern of so-called pain spots in the epidermis, and by the use of a finely pointed needle it may be shown that the skin varies in the amount of pain produced by a strictly localized injury. It is not known how the nerve terminations are stimulated to discharge nerve impulses. Nerve fibres are relatively resistant to mechanical stimulation, and it is not improbable that it is the living epithelial cells which respond to injury with the production of some chemical substance which provides the adequate stimulus. The persistence of the sensation of pain after injury favours the view that a chemical agent is the exciting factor.

There is even less satisfactory evidence as to the nature of the afferent fibres which convey the impulses to the central nervous system. There are at least two possibilities. According to Müller's law of the specific irritability of nerve, there should be special fibres for the conveyance of the impulses that give rise to pain. Some observers have claimed the existence of special pain fibres. Ranson states that they are small in diameter and non-medullated. They may belong to Erlanger and Gasser's *C* group; but these have a slow conduction rate, and, as Adrian points out, it is scarcely likely that pain—a danger signal—is dependent solely upon slowly conducting fibres. It is more probable that fibres of this description are concerned with the conveyance of pain from the viscera, but not from the outer covering of the body where the more rapid the response the better the protection afforded. The other possibility is that pain-producing nerve impulses are carried by nerve fibres which are normally concerned in the production of other effects, and that a more rapid series of impulses, or a greater mass effect, floods the central nervous system and overflows into tracts which convey pain-producing nerve impulses from more sensitive areas. The work of Adrian and others is on the whole opposed to this theory, and the trend of physiological opinion is at present in favour of the existence of specific pain fibres.

In the production of visceral pain, the utilization of nerve fibres ordinarily concerned in reflex action unaccompanied by conscious sensation is perhaps more likely, for it seems unreasonable to postulate the existence of special receptors and nerve fibres in organs which for many generations of individuals are never called into use.

However conveyed, all pain impulses appear to enter the central nervous system in Hughlings Jackson's lower level. In man a second neurone arises in the grey matter of the same side, decussates and runs upwards in the antero-lateral columns. Cases of syringomyelia support the view that in man there are special fibres in the spinal cord associated with the conduction of pain impulses. The fibres must make numerous connexions, for severe pain excites reflexes involving cardiac, respiratory and other vital physiological processes.

Afferent nuclei in the optic thalamus appear to be the basal receiving centres, and these in turn

transmit certain of the impulses to the grey matter of the cortex. There is reason to believe that impulses reaching the optic thalamus give rise to pain, but that the sensation produced there differs in some respects from that perceived by the cortex cerebri, the pain being more diffuse, less well localized and of a peculiar character. Pain felt by the thalamus has some of the characteristics of protopathic sensibility. Head's classification of body sensation into protopathic and epicritic has been much debated. There is no doubt the distinction exists; but its exact significance remains to be determined.

The physiology of pain in structures that lie deeper than the protective covering of the body presents further problems. Many tissues and organs of the body are capable of pain, but the adequate stimulus is often a specific one, and the injuries which produce pain in the skin or parietes fail to produce any sensation whatever in many of the viscera. Muscle, whether skeletal, cardiac or visceral, can be cut, burnt or otherwise injured without the production of sensation. Yet pain, and pain of a very severe character, can be experienced by muscle. The adequate stimulus is now believed to be tension, and particularly tension in the absence of an efficient circulation. Sir Thomas Lewis, from experimental evidence, believes that muscle under these conditions liberates some metabolic substance which diffuses rapidly and affects the sensory nerve terminations outside the actual muscle fibres. The nature of the pain-producing substance, factor *P*, is unknown.

The capability of experience of pain by the viscera may to some extent depend upon the presence in or around them of connective tissue sheaths. Peritoneal, pleural and other membraneous coverings carry their own nerve supplies, and these may be important factors in the reception and localization of pain. Pain from the viscera is commonly referred, not to the organ in question, but to some area of the body surface endowed with higher sensibility, and is then known as 'referred' pain. Prof. Waterston suggests that pain of this nature should be called 'heterotopic' to distinguish it from 'homoiotopic', or pain referred to its actual site of origin.

Ross was one of the first to attempt an explanation of visceral pain. He described two types, referred pain and true visceral or splanchnic pain. Mackenzie, impressed by his own observations on the insensitivity of the viscera, elaborated Ross's theory of the radiation of pain from the viscera to the parietes through an irritable focus in the spinal cord, but denied the existence of true visceral pain. Mackenzie believed that pain associated with a diseased viscus is never felt in that organ, but is always referred to an area of higher sensibility in the body wall. The pain may be extremely severe, and accompanied by reflexes, local and general. The local manifestations are of great value to the clinician in that they give him information as to the site and extent of the disturbance. The details of the work of Ross and Mackenzie have been much debated. Prof. Morley, who spoke at the meeting, considers that Mackenzie failed to appreciate the difference between referred pain from the parietal peritoneum and that from an intraperitoneal viscus. Morley believes that referred pain arises from the irritation of nerves sensitive to those stimuli which produce pain when applied to the surface of the body. He considers that pain from the urinary system, which is retroperitoneal, harmonizes with Mackenzie's view, though gastro-intestinal pain does not. The difficulty arises because of the complication introduced by the presence to a varying extent in the abdominal viscera of peritoneum and mesentery, structures carrying their own nerve supplies, and differing in their sensitivity.

Mackenzie believed that excessive contraction of muscle is the cause of pain in whatever viscus it is found. Colic and the pain of hunger may be cited as examples. Payne and Poulton, in a series of careful experiments, came to the conclusion that visceral pain from muscle is caused, not by its contraction directly, but by tension, and that the stimulus is a stretching and deformity of pain endings in the wall of the stretched viscus. The frequent association of pain with contraction is explainable on the assumption that excessive tension is put upon the tissues with which the contracted fibres are in continuity.

Headache presents another interesting problem. Apart from local conditions, such as neuralgia affecting the scalp, and vascular spasm in the tegumentary covering, headache is often a referred pain, and its source some part of the alimentary tract. The afferent nerves are those of the visceral fibres of the vagus, and the pain is referred to areas supplied by the trigeminal nerve. Some disturbance in the abdomen gives rise to pain which is felt as a headache. When the pain is of intracranial origin, its cause is now commonly ascribed to vascular changes in the pia-arachnoid membrane of the brain. The intravenous injection of histamine sets up severe headache. Histamine is a powerful vasodilator, and congestion of the blood vessels induced by its action is thought to be the cause of the pain. Withdrawal of cerebro-spinal fluid by lumbar puncture has much the same effect by decreasing the intracranial pressure. The receptors are apparently in the pia-arachnoid membrane, but may also be present in the choroid plexuses.

Even more interesting than pain is the problem of its relief. Intractable pain is fortunately rare but does occur in some diseases. Opium and its derivatives, though of great value, are not altogether satisfactory, especially when the pain is lasting; and they have other drawbacks. Section of afferent nerves, extirpation of ganglia and other destructive procedures, have been used in intractable pain. All such methods are attempts to prevent the passage of pain-producing impulses by the afferent nerves to the central nervous system. Mr. Todd described a method of alleviation by the intrathecal injection of alcohol. This paralyses the afferent fibres in the spinal canal, and has proved valuable in cases suffering from pain in the pelvis and lower limbs. There is still room for some drug which will possess the ideal properties.

METAMORPHISM AND IGNEOUS ACTION*

By Prof. H. H. Read, F.R.S.,

Imperial College of Science and Technology, London

Apart from the question of the time-continuity of the progressive series represented by, say, the Barrovian zones, there is the chemical continuity to be considered. How far do the zones of Barrow represent an isochemical series of pelitic rocks? The degree to which such processes as metamorphic differentiation and diffusion have operated obviously affects the compositions of members of the series at any stage. Such possible departures from the isochemical series arise through processes inherent in the rock. There is, however, another aspect of this topic which, though usually ignored in Great Britain, must in my opinion be carefully considered. The possibility of the introduction of material of so-called magmatic origin is one that certainly cannot be dismissed in the higher grades, and one that might apply even to the lower grades of regional metamorphism. It will be convenient for the development of my argument, however, if we transfer ourselves to the domain of ultra-metamorphism, and I discuss the reality of granitization, for, if granitization is real, certain consequences seem to follow.

In a paper which has appeared during the writing of this address, granitization is defined by Malcolm MacGregor and Gilbert Wilson as "the process by which solid rocks are converted to rocks of granitic character". It includes all such operations as palingenesis, syntexis, transfusion, permeation, metasomatism, migmatization, injection, assimilation, contamination, and the like. These authors conclude that exchanges take place between the country-rocks and their pore-fluids—whether these are entirely indigenous or reinforced by accessions from magmatic sources—and that these exchanges are selective so that there is a convergence, both chemical and mineralogical, of rocks originally different. They consider two processes to be concerned in granitization; first, a metasomatism under the influence of "permeating highly energized fluids—emanations—ahead of advancing magma", and second, a mechanical penetration by magma. I consider that no reasonable objection can be raised to these conclusions, notwithstanding the uncompromising attitude of Rosenbusch and others.

The question of room in migmatization is one that has caused difficulties to many observers. This room-question was answered by Hugh Miller fifty years ago, and has been answered many times since. Replacement is the essential process in the formation of the migmatites. It is unfortunate that the term injection-complex, used in Great Britain, emphasizes injection, since permeation, imbibition and metasomatism are more widespread phenomena. As I have pointed out elsewhere, the formation of banded gneisses and lit-par-lit complexes is best explained by a process of replacement to different degrees along layers of different permeabilities. The many examples of the tracing of the regional country-rock structure through granitic masses, the existence of thin plane screens of country-rock in them, the great extension of minute *lits* of quartzo-felspathic material in migmatites, and the detailed heterogeneity of many granites are all readily explicable by a replacement origin for these rocks.

Replacement in sedimentary rocks will be controlled by the original structures of such rocks. Permeation by the emanations or ichors will take place preferentially along certain layers depending upon both the chemical and physical nature of these layers. Original platy minerals lying in the bedding planes will become enlarged if they suit the new chemical environment, and new-formed minerals will grow so that their direction of greatest crystallization-velocity agrees with the old planes of weakness. The original sedimentary structure may thus become preserved until a high

*Continued from page 731.

degree of granitization has been reached, and the bulk composition of the rock has been greatly changed. I consider the foliation of granitic gneisses, for example, as essentially controlled by previously existing sedimentary structures, and not by any process of dynamic metamorphism or piezo-crystallization.

Whether the granitizing solutions are thought of as emanations of no specified ancestry, or as ichors from a granitic magma-body, opinion is agreed amongst workers in this subject that they are highly mobile and capable of great chemical action. Working in conjunction with the pore-fluids of the country-rock, they can transform vast portions of the crust. In connexion with direct granitic invasion, gases may be of great importance; when they have condensed to solutions and have received assistance from the true liquid residuals and from the pore-solutions, they must be capable of gigantic results. I wish to emphasize, therefore, that granitization and felspathization are valid processes, and that they are essentially based upon replacement.

In regions of granitization there has been an afflux of material, either from a 'magmatic' body or from some unspecified source. It is reasonable to believe that during the resulting replacement there occurs an emigration of material. Holmes has put the whole matter graphically—"the 'granite' is the balance of what was there originally, *plus* what has migrated in, *minus* what has been driven out". The emigrating material moves into the country-rocks adjacent to the theatre of granitization.

The material thus moving through the country-rocks is of several origins and qualities. It consists of (i) the material expelled from the region of granitization; (ii) the direct emanations from the granitizing agent; and (iii) the pore-fluids of the country-rocks. Its diverse constituents must move with different speeds, perhaps depending, as Backlund has ingeniously suggested, upon the ionic radii of the participating elements. Various overlapping belts of precipitation may come into being, and from each a further expulsion may take place. By some such processes zones of various characters arise about the granitization or migmatite core.

Wegmann has elaborated a magnesia-metasomatism dependent upon the expulsion mechanism in granitization; he expects to find a zone characterized by cordierite in close proximity to the migmatite area, whilst farther away would be found lower-temperature minerals like andalusite, kyanite, garnet, etc., and farther still tourmaline. The formation of 'fronts' of more or less marked chemical individuality can be exemplified by the soda-fronts of Stavanger, Sutherland, and Cromar, Aberdeenshire, by the potash-front of Hango, Finland, and by the magnesia-front of Orijärvi; there is no need to elaborate these examples.

One of the most firmly established facts of metamorphic geology is the close association in the field of highest grade metamorphic rocks and migmatites. The significance of this coincidence has been differently interpreted. I adopt the view of the company familiar with migmatites and see with them a direct causal relation between the highest grade of regional metamorphism and migmatization.

In my opinion, therefore, the cordierite and sillimanite zones are genetically related to granitization. But these zones are the final stages of the apparently continuous progressive series of Barrovian zones which as a whole supply the common types of regionally metamorphosed rocks. It seems reasonable to me, therefore, to believe that regional metamorphism as a whole is genetically related to 'igneous' activity of some kind.

Out from the central theatre of granitization there pass waves of metasomatizing solutions, changing in composition and in temperature as they become more distant from the core and promoting thereby the formation of zones of metamorphism about it. Very often a spurious depth control appears to have operated, since the flow of solutions must be largely towards higher parts of the crust. Such a metasomatic metamorphism accounts for the superposition occasionally observed of high-grade zones on lower-grade, and does away with the infelicities attending the alleged inversion of metamorphic zones. Further, the difficulties that the idea of static or load metamorphism fails to meet are surmounted. Deeply buried sediments remain unmetamorphosed unless igneous material gets access to them. In metasomatic metamorphism, original sedimentary textures can be reasonably preserved, mimetic crystallization can prevail, schistosity and bedding, even in violently folded strata, can coincide. Finally, all those phenomena which Daly felt to be "truly inexplicable by pure dynamic metamorphism", are satisfactorily explained.

A continuous series of changes in composition from low-grade regionally metamorphosed rocks to migmatites has been established by many investigations. Even in the low-grade rocks changes are perceptible, and all must be ascribed to the activity of material from a granitization centre. To move this material and to promote the recrystallizations and replacements that occur in cubic miles of rock, great quantities of solvents are required. It seems to me unlikely that the solvents in action are indigenous to the country-rocks—they are more reasonably to be derived from a granitic source. When the enormous

extent of migmatite granites is considered, it is clear that sufficient water is available to promote the changes seen in the regionally metamorphosed rocks.

Are there any indications in low- to medium-grade rocks, not visibly associated with igneous activity in the field, which point to solutions from magmatic sources having travelled so far from the locus of migmatization? In my opinion, we see such indications in the presence of tourmaline in rocks of all grades. Admittedly, this opinion is one not generally accepted in Great Britain, but on balance I prefer to regard most tourmaline in metamorphic rocks as due to impregnations from granitization fluids. Tourmaline occurs not only in pelitic derivatives but also in rocks of other compositions. In many examples of high- and medium-grade rocks it is clearly introduced, as shown by its relation to the other minerals present. I believe that the ubiquitous tourmaline in regionally metamorphosed rocks is an indicator of the action of 'emanations' throughout all grades.

Whilst I have belittled the role of the dynamic factor in regional metamorphism, it is of course true that in the lower grades it must be of considerable importance. How can this be reconciled with the view that migmatization is the prime cause of regional metamorphism? The reconciliation may be sought, I suggest, in the stresses set up by the increase of volume consequent upon the invasion of the crust by the migmatite front. Relief is obtained in the outer and cooler zones by shearing; in the inner and hotter zones by internal reconstructions. The unity of the zonal series may thus be preserved.

I have shown my predilection for dividing all rock transformations into two groups, one those of dislocation-metamorphism associated with dislocations of the crust, and the other those of regional and thermal metamorphism associated with igneous activity. My remarks, I trust, will receive thorough criticism. I am prepared for this, for, just as things too absurd to be said can yet be sung with perfect propriety, so views too tenuous, unsubstantiated and generalized for ordinary scientific papers can yet appear with some measure of dignity in presidential addresses.

POWDERED FUEL: PROGRESS AND PROSPECTS

THE necessity imposed by the demands of war to make use of any available materials in order to eke out inadequate supplies of the usual commodities is frequently the means of bringing to practical use ideas and inventions which might otherwise languish for years. An example is the introduction in the Napoleonic era of the present method of making soap in consequence of France being cut off from the usual supplies of kelp. The use of powdered fuel in aero-engines may, owing to Germany having difficulty in getting adequate supplies of petrol, be one of the results of the present hostilities; that the Germans have been working in this direction is evidenced by patents covering the use of powdered fuel. Patent literature shows that two distinct methods of operation have been envisaged. One consists in mixing the fuel with air and introducing the mixture into the combustion chamber, thus following the cycle used in petrol engines. The other adopts Diesel practice in injecting the fuel directly into the combustion chamber, though obviously with a fuel in the form of a powder some important modifications at the injection stage would be necessary.

Powdered coal cannot be described as a tractable material for the purpose of being metered out in small quantities for injection into the combustion chambers of a high-speed engine. Freshly pulverized, it is light and fluffy but, in the presence of moisture it readily tends to change its physical characteristics and to pack itself into a dense and rather inert mass. It is necessary, therefore, that it should be well dried before the final pulverization, and it is desirable also that it should not be kept in storage but rather used at once. After a long period of trial, it has now become well established as a boiler fuel, and a brief statement of its history in this connexion may indicate its possibilities.

In 1831, a patent was granted to John Dawes, ironmaster, for a method of introducing fuel into the blast of furnaces. Later patentees include the name of Mushet who, it will be noted, was also interested in steel furnaces. The first to advocate pulverized fuel seems to have been John Bourne, in whose "Treatise on the Steam Engine" of 1861 it is stated that "the fuel and air must be fed in simultaneously and the most feasible way of accomplishing this object seems to be in reducing the coal to dust and blowing it into a chamber lined with firebrick so that the coal dust may be ignited by coming into contact with the red hot surfaces". In 1868, T. R. Crampton experimented on the use of pulverized coal in steam boilers and puddling furnaces, and the views he put forward in a paper read before the Iron and Steel Institute

in 1873 have proved to be fundamentally correct. He was strongly insistent on the importance of the size of the fuel particles and of the intimate mixture of air and fuel.

It was not until 1895, when powdered fuel began to be successfully used in rotary cement kilns, that the system can be said to have become established. In this branch, however, its success has been so marked that it can be claimed to account for about four fifths of the world's output of portland cement. In this same year a remarkable result was obtained from tests carried out by Bryan Donkin in Berlin. A Cornish boiler was operated for one day by hand-firing on the ordinary grate; two days later, after being fitted with the Wegener apparatus, it was given a day's run on powdered coal. On the first occasion the thermal efficiency was 54 per cent, whereas on the second it was 77 per cent, the total duration of smoke in the two tests being 105 minutes and 6 minutes respectively.

In view of these figures, it is remarkable that the development of this method of firing has been so retarded and that in England, even now, the number of plants in operation is very limited. This is not explained by any inherent difficulty, as the crushing, drying, pulverizing and delivery plant are of robust construction and generally reliable in operation. The risks associated with the use of pulverized coal can be controlled by strict attention to cleanliness in the boiler house and to the cleaning of all pipes when closing down. The powdered fuel is entrained in a limited blast of air which, before entering the furnace, is enabled to carry with it the additional amount of air requisite for combustion. As the carbon dioxide percentage may be as high as 15, it can be seen that the proportion of excess air is lower than that needed for ordinary coal firing, where 12·5 per cent is the normal figure for carbon dioxide. The ash produced is a very finely divided flocculent powder, and the amount which escapes to the atmosphere can be reduced to any desired degree by suitable interceptors.

The history of the efforts made to use coal dust directly in internal combustion engines is in strong contrast to the record just given, as the main problems have not been satisfactorily solved. It is an interesting fact that when Diesel, about 1890, was planning the type of engine which now bears his name, his primary idea had been to employ coal dust as fuel. After several years of experimental work, the engine which he constructed proved to be adapted to oil fuel but not at all to coal or even gas, and so for this as well as economic reasons its ultimate development was directed toward the utilization of oil. At the Glasgow Exhibition of 1901 there was shown an engine made to the patents of 1894 and 1900 of P. F. MacCallum, which developed 100 B.H.P. at 150 r.p.m., using coal dust as fuel. The difficulty of completely consuming the solid particles was never fully overcome, no matter how finely the coal was pulverized, and this continues to be one of the chief problems to be solved. The ash is also troublesome and inevitably so, for the limited combustion space offers little scope for devising means of interception and control.

These considerations suggest that, instead of the direct use of coal dust in the engine cylinders, some indirect or semi-direct method might be developed. The use of a special form of gas producer is an indirect method, but so much so as to come under a different classification, the engine becoming a gas engine supplied by gas from an individual gas generator. The term semi-direct is intended to suggest an arrangement whereby the processes of combustion are isolated from the cylinder, but in which the working substance is the gas formed by combustion. The indirect method, on the other hand, would be one in which the products of combustion do not enter the cylinder but are enabled through another medium to do work on the piston. It is never possible to forecast how practical conditions may modify theoretical suggestions, and it will be interesting to see by what means the coal-firing of engines, if indeed it is practicable, will be realized.

OBITUARIES

Dr. W. B. Wright

DR. W. B. WRIGHT, lately of the Geological Survey of Great Britain, died on October 11 at the age of sixty-three years. Wright received his university training at Trinity College, Dublin, which in 1928 honoured him with the Sc.D. He approached geology through mathematics, being attracted by Croll's astronomical theory of ice ages. He joined the Geological Survey of Great Britain and Ireland in 1901, and to begin with had the good fortune to work in the Dublin, Belfast, Cork and Limerick districts under the inspiring leadership of the great glacialist Lamplugh. During these early years Wright's most original contribution was a joint account with Maufe, published in 1904, of a low pre-Glacial raised beach preserved at many points

around Ireland. A similar feature had long been familiar to geologists on both sides of the English Channel and in South Wales and Yorkshire.

During 1904, a year before the separation of the Geological Survey of Ireland, Wright came to England. Here in the Midlands he encountered the Millstone Grit and Coal Measures, which later came to mean so much to him. He also learnt at close quarters the elusiveness of the Older Glaciation of this district.

In 1906, eager to rejoin his friend Maufe, Wright transferred to Scotland, where he worked officially in the West Highlands and Midland Valley, and unofficially everywhere on the coastline. His main discoveries were: two earth movements separated by a period of igneous activity and recorded in the disturbed Torridonian of Colonsay; a pre-Glacial 100-ft. beach in the same and neighbouring islands; and north-west symmetry in the Tertiary volcanic centre of Mull. Wright was in at the beginning of the detailed study of Mull, and though one contribution is here singled out for special recognition, he had a lion's share in the elucidation of the whole. Wright also played an important part in developing the coalfield technique of the Edinburgh office of the Survey.

In 1910 Wright was appointed to the Irish Survey, where he did good work during the next ten years. It was in this period that he sponsored a deep bore at Lough Neagh, in search of a concealed coalfield, but the results, published in 1924, proved disappointing from the economic point of view. In 1914 Wright produced his *magnum opus*, "The Quaternary Ice Age", which put all the world in his debt by collecting and correlating in one volume a vast amount of international literature, not easy of access and definitely difficult to assess.

In 1921 Wright was invited to return to England to undertake for the Geological Survey of Great Britain the organization of a branch office in Manchester and the revision of the Lancashire coalfield. His success was outstanding, and his staff has covered the area with excellent maps and descriptive memoirs. He gave special attention to palæontology and to actual inspection of underground workings. At first he studied the Millstone Grit, and here received much help from Bisat, the chief of goniatite experts; but the return he made was generous. Moreover, he brought the modern work to the notice of a wide public in his section on the Millstone Grit contributed to the "Handbook of the Geology of Great Britain", a compilative work that appeared in 1929.

Presently Wright specialized on the Coal Measures, and produced splendid results in the form of subzones, based on freshwater mussels. Like certain others of his countrymen, Wright had a pugnacious tendency, which has perhaps concealed the comradeship that exists in this difficult field, or, one would like to say, pool, of research. He stood for the definition of a fossil species in terms of a type specimen that one can handle, rather than in terms of a synthesis derived from an assemblage of specimens, which, in the researcher's opinion, would have been able to interbreed if they had lived together in time and space. There is evidently more than one way of attacking this difficult problem, but Wright's method of convenience has certainly given valuable results, valuable to industry as well as to science.

Wright's latest publications have been a second edition of his "Quaternary Ice Age" (1937), and "Tools and the Man" (1939). These clearly reveal that whatever else caught his fancy on the way, he remained ever true to his early glacial love.

Wright is survived by a widow and a daughter, both of whom take an active interest in zoology.

E. B. BAILEY.

Dr. G. A. Sutherland, C.B.E.

WE regret to announce the death on October 10 at the age of seventy-eight years of Dr. George Alexander Sutherland, consulting physician to the North West London Hospital and the Paddington Green Hospital for Children. Although ill-health had compelled him to retire from practice many years previously, he was at one time one of the best-known London specialists in children's diseases. He was born in 1861 at Aberdeen, the third son of the Rev. James Sutherland, and was educated at Aberdeen, where he graduated M.A. in 1882 and Edinburgh, where he became M.B. in 1886 and M.D. in 1893, after which he took a post-graduate course in Vienna.

Sutherland took an active part in the formation in 1900 of the Society for the Study of Disease in Children, as well as in the amalgamation of this Society eight years later in the Royal Society of Medicine. In 1906 he was made president of the Pædiatric Section for the annual meeting of the British Medical Association at Toronto, and in 1911–12 was president of the Section for the Study of Disease in Children of the Royal Society of Medicine. In addition to contributions to periodical medical literature and to Latham and English's "System of Treatment", he published in the series of Oxford Medical Publications works on "The Treatment of Disease in Children" (1907 and 1913) and "The Heart in Early Life" (1914). In 1917 he delivered the Lumleian Lectures before the Royal College of Physicians, of which he had been elected a fellow in 1903, his subject being "Modern Aspects of Heart Disease". He was also editor of a "System of Diet and Dietetics" (1908), to which he contributed three chapters on diet in diseases of the lungs, the feeding of infants and children in health, and diet in diseases of children. During the War of 1914–18 he was appointed consulting physician to the Royal Air Force and was created C.B.E. in recognition of his services. He was unmarried.

J. D. ROLLESTON.

WE regret to announce the following deaths:

Mr. T. D. Rice, senior soil scientist of the Bureau of Chemistry and Soils, U.S. Department of Agriculture, on September 12, aged sixty-one years.

Prof. R. V. Wheeler, professor of fuel technology in the University of Sheffield, on October 28, aged fifty-six years.

NEWS AND VIEWS

Nobel Prizes for Physiology and Medicine

Prof. C. Heymans

Prof. Corneille Heymans is professor of pharmacology in the University of Ghent, being the direct successor in that chair to his father, the late Prof. J. Z. Heymans, in collaboration with whom he had carried out researches, involving some of the ingenious methods of cross-circulation and artificial perfusion, which he has later developed in the series of masterly investigations which have just been recognized by the award of the Nobel Prize for Physiology and Medicine for 1938. Some of Prof. Heymans' most important work has dealt with the sensory mechanisms in the vascular system, through which the arterial blood pressure is kept under reflex nervous control. This sensory function of the carotid sinus had been discovered and described by H. E. Hering and E. Koch in Germany, but the work of Heymans greatly extended knowledge of its importance and demonstrated the presence of analogous sensory apparatus in other parts of the vascular system. Heymans also discovered the sensitiveness of the carotid sinus to chemical changes in the blood, and its consequent importance in regulating the activity of the respiratory centre. Prof. Heymans is responsible for many other important advances in physiology and pharmacology, largely concerned with the control of the circulation. He is well known outside his own country, and a frequent and welcome visitor to Great Britain, where his remarkable command of English, as of several other languages, enables him to give clear and fluent accounts of the progress of his researches, and where the honour now done to him will be warmly greeted by his many friends and admirers.

Prof. G. Domagk

Prof. Gerhard Domagk, who has been awarded the Nobel Prize for Physiology and Medicine for 1939, is the pathologist to the medical and biological research laboratories of the Bayer Company of Elberfeld. Domagk was comparatively little known, beyond the range of those familiar with the work of that institution, until, nearly five years ago, he made a discovery which has led to one of the most rapid and remarkable advances on record in therapeutic science and practice. The late Paul Ehrlich began his researches in chemotherapy with the attempt to find substances which would deal directly, as disinfectants, with bacterial infections in the living body. He, like many others who have followed, abandoned what seemed to be a hopeless quest, and turned his attention to the discovery of chemotherapeutic remedies for infections due to protozoa and spirochætes, the most important outcome being the discovery of salvarsan. It had almost come to be assumed that bacterial infections were beyond the reach of chemotherapy, though Morgenroth's 'Optochin' and its allies had given some hope of eventual success. Domagk appears to have examined a series of dyes for their action on streptococcal infections in the living body, irrespective of a lack of disinfectant properties outside it. In January 1935 he described the remedial effect on streptococcal infections in mice of a red dye, named 'Prontosil', an amide of chrysoidine, which had been prepared by Mietzsch and Klarer, chemists on the staff of the Bayer Company. Some confirmatory clinical results were obtained, but the first organized trial of 'Prontosil' on a uniform series of cases of streptococcal infection in man was made by Colebrook in Great Britain.

Meanwhile, it had been found by Trefouel, Nitti and Bovet, in France, that a simpler, uncoloured component of 'Prontosil', sulphanilamide, had a similar action; and there seems reason to believe that this is the direct antistreptococcal agent, being split off in the body from 'Prontosil'. Since then, each month has seemed to bring evidence of the therapeutic importance in some new direction of 'Prontosil', sulphanilamide, or one of the numerous derivatives made from the latter in many countries; a conspicuous example being the pyridyl-sulphanilamide (M. & B. 693) made by Ewins in Great Britain, and shown by Whitby to have special activity in pneumococcal infections, such as lobar pneumonia. The result of this development has the aspect of a revolutionary advance in therapeutics, and there will be general satisfaction, among medical research workers and physicians in all countries, that the Nobel Committee have thus recognized the pathologist whose initial discovery opened the way to such a great development.

Prof. V. L. Komarov

In honour of his seventieth birthday and in appreciation of his great services to science, the Soviet Government has awarded the Order of Lenin (the highest Order in the Soviet State) to Prof. V. L. Komarov, president of the Academy of Sciences of the U.S.S.R. The name of Vladimir Leontievitch Komarov will always be inseparably associated with the flora of Manchuria. Komarov was attached to the Russian expedition to Manchuria in 1896, and during this and subsequent years made extensive botanical collections, duplicates of which were distributed to the principal herbaria of the world. The outcome of these collections was the valuable and detailed three-volume "Flora Manshuriæ", published in parts in the *Acta Horti Petropolitani* from 1901 until 1907. In 1908 Komarov joined the expedition of Theodor Pavlovitch Riabushinsky to Kamchatka, where he remained for two years, collecting assiduously. Accounts of the botanical results of the expedition were published by Komarov

in "Zwei Jahre auf Kamtschatka" (1911) and in "Voyage en Kamtchatka en 1908–1909", forming part of the official account of the expedition (1913). During 1931–32, in collaboration with Mme. Klobukova-Alisova, Komarov published a "Key to the Plants of the Far Eastern Region of the U.S.S.R." in two volumes, and in 1934 appeared the first volume of the magnificently conceived and executed "Flora U R S S". This truly monumental work, of which at least seven volumes have already appeared in rapid succession, is the result of the collaboration of numerous Russian botanists under Komarov's general editorship. We sincerely trust that Prof. Komarov may live to see the completion of his crowning work.

German Culture in Prague

A report from the Protectorate of Bohemia and Moravia announces that the German University of Prague has been reconstituted as a Reichsdeutsch University "to serve as a centre for German cultural expansion to the south-east of Europe". This status was made legal on October 1 and necessitates the appointment of Nazi professors to Prague. They are to be accompanied by a large body of students drawn from all parts of Germany. In the past, this German university in Czechoslovakia attracted many well-known specialists from Germany and Austria. Indeed, it was the policy of the former Czech Ministry of Education to encourage such appointments in order to ensure a high standard both of teaching and scientific research. The new appointments are, however, avowedly not for scientific advancement but for Germanization, a process that is being pursued also by the schools throughout the protectorate as well as in the Sudeten territory acquired by Germany in September 1938. Meanwhile, Czech and non-Nazi professors are drafted into labour corps. A number have succumbed to this inhuman treatment, including Profs. Charvat and Bělohradek. Despite the deplorable setback to science and learning in Central Europe, the Czechs are still attempting to continue with their investigations. An instance is afforded by the recent archæological excavations near Mělnik, where a prehistoric settlement has been unearthed. The objects discovered are believed to date from the time when Slav tribes first settled in the Elbe valley.

The Linnean Society

In addressing the Linnean Society of London meeting on October 26, the president, Dr. J. Ramsbottom, said that the Council had already taken steps before May last to protect the Society's treasures; the Linnean collections (specimens and books) were moved, and the medals and other valuables from the Iron Chest. Since the outbreak of hostilities the Smithian Herbarium and some smaller collections have been moved and stored in what is hoped to be a safe place. It is the unanimous decision of the Council that the Society should carry out its normal activities so far as is possible. This is in the best interest of fellows, of the Society, and of the subjects in which the Society is interested. Apart from the communications at meetings it is essential that biologists should have an opportunity for informal meeting at some central place in London. Therefore the Society is keeping its rooms open and allowing them to be used by other societies or bodies of biologists who are in need of such a meeting-place either for formal or informal discussions. In 1914 the time of meeting was altered from 7 o'clock to 5 o'clock because of moonlight nights—moonlight nights had been favoured in the early days of the Society, before streets were properly lighted. Now because of the black-out it is necessary to hold meetings earlier. The next meeting will be held at 2.30 and the following—summer-time being ended—at 2.15.

Museums and the War

On the outbreak of war many museums were closed to the public, following the example of the various national museums under Government control. It was a regrettable move on the part of the Government, for these institutions are centres of education and mild recreation, as well as repositories of valuable specimens, and the use of them would have been a welcome relief from more stern affairs to many of the public and the troops. Now in a pamphlet issued by the Board of Education, entitled "The Schools in War-time" (Memorandum No. 4), "The Use of Museums" is discussed, and we have the curious spectacle of the president of the Board of Education urging the value in war-time of museums and urging the use of museums, while those museums over which he has some measure of control remain closed. Nevertheless the policy which he urges in this pamphlet is the right one, and War Circular No. 1 of the Museums Association on "Museums and the War" gives a lead. Not only is it desirable, according to this circular, that existing museum services should continue, but also that additional educational services should be provided. Ways are shown in which museums can help. It is probable that in many cases reduction of staffs may render special efforts impossible; but it is not a serious matter to make halls and galleries, as many as the number of attendants will allow, available for the public.

The Electrical Grid in Great Britain

In view of the decision of the Institution of Electrical Engineers to hold no meetings of the Institution in London during the first half of the session, a copy of the address of Mr. Johnstone Wright, president of the Institution and chairman of the Central Electricity Board, which he would have delivered normally on October 26, has been posted to every member in the United Kingdom and Eire. His choice of the construction and operation of the Grid as the subject of his address was a happy one, owing to the significant coincidence that the incoming president on the outbreak of the War of 1914–18 was the late Sir John Snell, to whose vision, enthusiasm and advocacy the Grid is so largely due. The deficiencies in national electrical organization revealed by that war resulted in the establishment of the Grid. It is not too much to claim that the Grid has a vital national role in the present struggle. The Grid con-

struction and standardization of frequency planned in comparative prosperity of 1924–29 and carried out largely in the period of acute depression which followed, resulted in a large increase above the normal capital expenditure of the industry at a time when such expenditure was most needed. The policy had the valuable effect of affording manufacturers in Great Britain extensive and intensive experience in designing and constructing large high-voltage power plant, thus putting them in a position of equality with their competitors abroad.

In 1924–25 seventeen different frequencies were employed in the A.C. system of Great Britain. The experts advising the Weir Committee considered that the standardization desirable for grid purposes, if undertaken in 1924, would cost 10½ million pounds sterling. By the time the work was actually put in hand, on dates spread over the period 1928–30, the estimated gross cost was 18½ million pounds. The actual expenditure when the work was complete was 17·3 millions, some part of which is recoverable. Had the decision to standardize been delayed until the present time, the cost would have been well over 30 millions. The savings attributable to the Grid system, already large, would not have been on the same scale had standardization not been undertaken. The national defence requirements have undoubtedly been simplified by the existence of a national standard frequency basis. In conclusion, Mr. Johnstone Wright said that the parts to be played by the Institution in improving and developing the personnel and equipment required by the electrical industry and in furthering the cause of international engineering co-operation, are both onerous and honourable.

Reincarnation of a Dalai Lama

During the five years which have elapsed since the death of the Dalai Lama of Tibet, reports have appeared of the progress made in the search for his successor. According to Lamaistic belief, when a Dalai Lama dies, his spirit is reincarnated in the body of his successor, born at the moment of his death. The records of early travellers in Tibet bear witness to the elaborate precautions taken to ensure the true succession to the holy office, and the careful, if reverent, regimen to which its youthful occupant is subjected. Lhamo Dhondhup, the new Dalai Lama, now some five years of age, was born in Amdo Ari, near Kumbum, in Silling and at his birth there was a rainbow over the house. Some particulars of the signs by which the authenticity of the reincarnation was attested, as reported from Tibet, are transmitted by the Delhi correspondent of *The Times* in the issue of October 29. Not only had the existence of the reincarnated Dalai Lama and his whereabouts been indicated in a vision, according to precedent, but also when visited by the search party, disguised as traders, he recognized their holy calling and distinguished between the status of the individuals who composed the party. He took hold of the rosary which had belonged to the late Dalai Lama, telling the beads and repeating the Buddhist formula "Om Mane Padme Hum". In a further test, when the Dalai Lama's rosary, small drum and walking stick were offered him, he chose those which had been his own in his previous incarnation in preference to the replicas presented to him at the same time—a test in which another aspirant to the office failed.

African Studies

In "African Survey", Lord Hailey, in discussing the future of African studies, stressed the fact that there was no less need for organized research in the social sciences than in the natural sciences. It was inevitable in a survey of so wide a scope that any recommendations made would cut across existing activities. This was recognized in the credit accorded to existing organizations, in which prominence was given to the work of the International Institute of African Languages and Cultures, not only on account of its specific interests, but also on account of its facilities for collecting information through its international relations. In the recently issued report of the Executive Council of the Institute (*Africa*, **12**, 4, 1939) it is recalled that discussion of plans for future research had been postponed pending the publication of Lord Hailey's "African Survey". It is now announced that on the appearance of that report, the authorities of the Institute initiated conversations with Lord Hailey with the view of obviating the dangers of overlap in a common field and competition in the sources from which funds are derived. The possibilities of co-operation are now under discussion, and a scheme for associating the continuation of the Hailey Survey work with the work of the Institute has already been approved in principle by the Council for elaboration by the Institute's officers.

British Museum (Natural History): Recent Acquisitions

Mr. Robert W. Oates has presented a portrait of J. J. Audubon, the father of American ornithology. This portrait is a copy by Lance Calkin of the so-called hasty portrait which Audubon drew of himself in Liverpool in 1826, and which was reproduced in Buchanan's life of Audubon. Unable to find sufficient subscribers in the United States for his projected work on the birds of America, Audubon, at the age of forty-one, came to England for the purpose of finding additional supporters. After visiting a large number of towns in England and Scotland, exhibiting his pictures and meeting a number of well-known people, Audubon collected sufficient subscribers to enable him to commence publication of "The Birds of America". This great work—unique of its kind—was published in London in four volumes (elephant folio), with life-size drawings of the different birds, between 1827 and 1838. Mr. J. F. Marshall has presented to the Trustees five large oil paintings of birds by R. Havell, who engraved many, if not all, the illustrations for Audubon's book.

A beautiful specimen of foliated gold in quartz, probably of Australian origin and formerly the property of the late Walter Claude Johnson, founder of Messrs. Johnson and Phillips, has been presented

to the Department of Mineralogy through his friend Mr. G. Leslie Wates. Further gifts of tourmaline, sapphire and hæmate from Burma have been made by Mr. A. C. D. Pain. A new find of tektites, small glass bodies of curious shape and unknown origin, has recently been made in Texas and a few good specimens have been acquired by exchange with the University of Texas. Also a slice of the New South Wales meteoritic stone Narellan, new to the Museum collection, has been acquired by exchange with the Australian Museum. Among the few purchases approved by the Trustees are included two good crystals of olivine from the Red Sea, and some parti-coloured tourmalines and cordierite from Brazil. The Department of Botany has received about 1,750 plants from North Burma and Assam collected by Captain F. Kingdon Ward on his latest expedition. He visited China intending to proceed to the Shan States and south-west Yunnan, but after six weeks (a month of which was spent under open arrest) he left China and went to North Burma. In 1938 he spent six months in the Eastern Himalayas and then joined the Vernay–Cutting expedition to the Burma-China frontier.

Electric Propulsion at Sea

A. C. HARDY, in the *Electrician* of October 13, discusses the part that electrically propelled ships are likely to play in the present conflict, and whether this is likely to have a great effect on the future of electrically propelled and Diesel-electric ships. A number of coasters use Diesel generating power not only for propulsion but also largely for winches, windlass and other ancillary purposes. In Amsterdam, turbo-electric vessels are being built and they are now fitting out a pair of 'units' with a special method of propulsion. One of these two ships is the passenger and cargo turbo-electric vessel *Josef Stalin*, designed by the Netherlands Shipbuilding Co. for the Soviet Government, in accordance with the requirements of the U.S.S.R. Shipping Register. This vessel and her sister ship have accommodation for 48 first-class, 164 second, and 296 third-class passengers and also a crew of 102. They have a length of about 133 metres overall with a beam of 18·5 metres, a depth of 9·65 metres and a gross tonnage of about 7,500. It is stated that their turbo-generators deliver about 14,000 S.H.P., to the two shafts. In this respect, on two screws the new ship will develop within 1,000 h.p. of the maximum output of the big German liner *Patria*, the largest Diesel-electric ship afloat. The *Josef Stalin* and her sister ship are expected to have a speed of about 20 knots and they will be among the fastest electric ships in existence. Three large turbo-electric all-welded vessels which were launched recently in the United States have made a great step in advance by using very high pressure and very high temperature steam. If the future should show that there will be a demand for Diesel engines applied to ships having even higher powers than they have at present, it looks as if the struggle for supremacy would lie between Diesel-electric A.C. drive and Diesel-geared drive.

Recent Earthquakes

DR. G. VAN DIJK of the De Bilt (Holland) seismological observatory recorded fifteen large earthquakes during August and fourteen during September 1939. One of the largest recorded at De Bilt was that of August 3, which probably had an epicentre 2,350 km. from De Bilt in an approximately easterly direction. Preliminary determinations of epicentres have been made by the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association showing the earthquake of August 12 to have been in the north Pacific Ocean off Japan, that of August 24 in the Pacific Ocean near Central America, and that of August 26 in the Pacific Ocean near the New Hebrides. The somewhat deep focus (60 km.) earthquake of September 8 had an epicentre in lat. 51° N., long. 175° E., just south of the Andrean Islands, which are part of the Aleutian Islands. This was near the epicentre of the very strong 'missing earthquake' of November 10, 1938. The shock of September 21 had its epicentre near the island of San Luis in the Gulf of California in a region which is liable to small earthquake shocks. Kew reported that six strong earthquakes were registered on the seismographs during September, the latest to be recorded being on October 10, with a possible epicentral distance of 88° and rather deep focus (75 km.).

Forestry Abstracts

THE Imperial Forestry Bureau at Oxford has commenced the issue of a publication entitled *Forestry Abstracts*. The lines upon which this quarterly journal, as it is designated, are based, follow those of the well-known *Experiment Station Record* of the United States Department of Agriculture, which is now in its eightieth volume. This latter publication is not, however, confined to forestry. *Forestry Abstracts* is intended to record in the English language brief reviews and précis of the current forestry literature of the world. The general idea is that each issue will include short reviews of literature in different branches of forestry, with notes on annual forestry reports, and abstracts classified by subjects. "In the abstracts the aim is to epitomize the contents of each paper so as to enable the reader to judge of its value as a contribution to knowledge". The subject headings are as follow: General Forestry; Fundamental Natural Laws of the Forest; Tree Species; Forest Botany; Forest Zoology; Sylviculture; Utilization; Technology; Protection; Increment, Yield; Management, Working Plans, Surveys; Economics; Administration; Policy.

Indian Journal of Entomology

WE have received a copy of the first issue of a new zoological periodical entitled the *Indian Journal of Entomology* (vol. 1, pts. 1 and 2. June 1939). This journal is to be published twice a year by the Entomological Society of India and the subscription price abroad for non-members of that Society is Rs. 16 per annum. All communications should be addressed to the General Secretary, Entomological Society of

India, Agricultural Research Institute, New Delhi, India. It is intended to publish papers on both pure and applied entomology, besides short notices about new books and reviews of recent research, etc. The chief editor is Dr. Hem Singh Pruthi who, with five other Indian entomologists, forms the editorial board. The present number is well produced; it contains eight scientific articles and runs to 137 pp. together with illustrations. We wish this new journal every success, and if it results in the 'localization' of much future Indian entomological work within its pages, instead of the present diversity of sources for its publication, it will prove a definite boon to workers all over the world.

Bibliography of Drosophila

STUDENTS of genetics have for a long time past needed a guide to the immense amount of genetical work done on Drosophila. This need has been supplied by the publication of a "Bibliography on the Genetics of Drosophila" by the Imperial Bureau of Animal Breeding and Genetics. Dr. H. J. Muller has compiled not only papers of special interest to workers on Drosophila, but also those more general papers which shed light on problems which affect both Drosophila and genetical thought. The bibliography is particularly valuable in that it provides cross references where several authors are involved in one paper, and in the adequate reference to Russian literature.

Chemical Club

THE Chemical Club is continuing to function at its house at 2 Whitehall Court, London, there being good air raid shelters in the premises. There is a feeling that the Club will be used more and more during time of war, since enlarged acquaintanceship and cheerful association are definite factors in the present national effort. The annual general meeting will be held at the Club on Tuesday, November 14, at 2 o'clock. The popularity of lunchtime meetings since the war started is expected to result in a good attendance. The report of the executive committee for the year 1938–39 speaks of a year of successful social and other activities. The Committee has nominated for the ensuing year Mr. F. Arnold Green as president, Dr. H. E. Cox as chairman of the executive committee, and the continuation in office of the honorary treasurer and honorary secretary, Dr. S. I. Levy and Mr. F. J. Bullen respectively. The Committee will recommend to the annual general meeting that in view of the number of clubs which are offering temporary membership to uniformed members of H.M. Forces, the Chemical Club should provide parallel concessions by offering facilities, at a nominal subscription, to those who, although not in uniform, are engaged in London on Government work. This temporary measure is one likely to be highly prized by chemists and others so situated.

World Power Conference

IR. G. J. T. BAKKER, chairman of the Netherlands National Committee of the World Power Conference, has agreed to become acting chairman of the International Executive Council of the Conference during the War. Correspondence intended for the International Executive Council should be addressed to the Secretariat, International Executive Council, World Power Conference, Vereeniging voor Congressen op Electrotechnisch en Aanverwant Gebied, Utrechtscheweg 210, Arnhem, Holland. Correspondence for the British National Committee should, as at present, be addressed to 36 Kingsway, London, W.C.2. Orders for any World Power Conference *Transactions* should be sent to Messrs. Percy Lund, Humphries and Co., Ltd., Country Press, Bradford. Orders for the publications of the Central Office of the World Power Conference, including the Statistical Year-book of the World Power Conference, should be directed to the British National Committee. Special arrangements have, however, been made with respect to "Technical Data on Fuel", orders for which will be dealt with by the Secretary, Society of British Gas Industries, Uplands, Epsom Road, Guildford, Surrey.

Announcements

PROF. E. SCHRÖDINGER is now in Dublin, and is delivering a course of lectures which began on November 3 at University College, Dublin, under the title "An Elementary Introduction to Wave Mechanics".

DR. ICIE MACY-HOOBLER, director of the research laboratory of the Children's Fund of Michigan, Detroit, has been awarded the 1939 gold medal and the thousand dollars prize of the Borden Company for outstanding research achievement in applied nutrition.

IN view of the importance of chemical engineering at the present juncture, the Ramsay Laboratory of Chemical Engineering at University College, London, has reopened, and students will be accepted for training in chemical engineering and research forthwith.

MEETINGS of the Quekett Microscopical Club are taking place on the third Saturday afternoon of each month at 2.30 p.m. in the Club's rooms at 11 Chandos Street, Cavendish Square, London, W.1.

THE general discussion on "The Properties and Testing of Heat Insulating Materials" organized by the Joint Committee on Materials and their Testing in conjunction with the Institution of Gas Engineers arranged for November 23, has been postponed.

OF the two million babies born annually in the United States seventy-five thousand are stillborn, and thirty-nine thousand die during the first month of life. Approximately twelve thousand mothers die from causes directly related to child-bearing, many of which are preventable through combined individual and community action.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 788.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Intensity of Mesotrons in the Upper Atmosphere

In view of the well-established decay of the mesotron and of the magnitude of the sea-level latitude effect, it is now certain that all mesotrons found have been produced in the atmosphere. It is therefore of great interest to measure their intensities at different heights, particularly at levels where they may be expected to have been produced.

Balloon flights have been made near Edinburgh during the past summer with this object. Triple coincidence counters, shielded with 10 cm. of lead disposed equally between them, have been used. The counters were coupled to a radio transmitter, which was a modified form of that used by Carmichael and Dymond[1]. The thickness of lead was sufficient to absorb completely all electrons. In order to reduce the weight of absorber it was necessary to employ small counters, so that the ground rate of counting was only 0·4 per minute. Because of this small number, the statistical fluctuations in counting during the flights were high, and consequently a large number of flights would be required to obtain an accurate picture of the variation of intensity with height. As the work has now to be broken off, it seems desirable to record the results so far obtained.

Three flights have been made, which indicate that the intensity of vertically directed mesotrons rises to a maximum at a pressure of about 80 mm. mercury (16 km. height), the same point where the maximum for all particles (unshielded counters) occurs, and that its value at this height is approximately nine times the ground value. This should be compared with the increase of about forty times found by Pfotzer[2] and by Carmichael and Dymond[1] with unshielded counters. It is probable that the true increase is even less than this, as the counters, being only shielded in the vertical direction, can record showers coming in laterally. Soft showers of this nature are likely to be numerous at these altitudes, but at present there is no means of finding what correction must be made for them. At heights greater than that corresponding to a pressure of 80 mm. mercury, the intensity appears to decrease rapidly, but the rate of decrease is uncertain, due to the statistical errors mentioned.

These results are of particular interest when viewed in conjunction with Euler and Heisenberg's theory[3] of the intensity variation of mesotrons in the atmosphere. Their assumption that the maximum production of mesotrons occurs at the maximum of the normal transition curve in the atmosphere is shown to be correct.

Also, from the observed ratio of intensities at the ground and at the maximum, some conclusions as to the energy distribution of the particles at their formation can be made. Euler and Heisenberg have assumed that the number of mesotrons with energies greater than E is given by $J(E_0/E)^\gamma$, where $\gamma = 1{\cdot}87$. This is the same distribution as that of the primary particles as shown by the latitude effect, and they show that it leads to the correct energy distribution at sea-level. If we exclude all particles of energy less than $1{\cdot}2 \times 10^8$ ev., which will be unable to traverse the lead between the counters, their results lead to the total intensity at 80 mm. mercury pressure, being 390 times that at the ground, compared with the observed value of nine.

The discrepancy can be removed, however, if we assume that there is a minimum energy with which mesotrons are produced of about 8×10^8 ev. If the energy distribution is cut off at this value, Euler and Heisenberg's expression leads to the right value of the intensity ratio at the two heights.

The method of formation of the mesotrons is still unknown, although there is some evidence that they are produced by protons and not by shower particles. It should be noted, however, that the minimum energy of primary electrons in the latitude of Edinburgh is 2×10^9 ev., which is degraded by shower formation to from 5 to 7×10^8 ev. at 80 mm. pressure, the same order of magnitude as the minimum energy of the mesotrons.

In conclusion, I must thank many of my colleagues in the Department for their assistance with the balloon flights, and in particular Dr. C. B. Childs and Mr. A. Cowie.

E. G. DYMOND.

Department of Physics,
University of Edinburgh.
Oct. 2.

[1] Carmichael and Dymond, *Proc. Roy. Soc.*, A, **171**, 321 (1939).
[2] Pfotzer, *Z. Phys.*, **102**, 23, 41 (1936).
[3] Euler and Heisenberg, *Ergebn. exact. Naturwiss.*, 17 (1938).

Absolute Measurement of Electrical Resistance

In recent years, at Birkbeck College, attention has been given to various methods of measuring electrical resistance absolutely. On the eve of war, this series of researches has been brought to a conclusion by the development of a method in which the potential difference across a resistor is balanced by the average E.M.F. of a commutating generator. Although Rosa[1], so far back as 1909, suggested such a method and proposed a form of apparatus, difficulties were encountered and no experimental data derived from any form of this method have been published. The method is attractive in requiring only the measurement of a frequency and a maximum mutual inductance.

By a new method, the rotor is made to have such an extremely flat maximum of mutual inductance with the field coils that, over a range of some 14° in the neighbourhood of commutation, no E.M.F. is generated. Further, over an adjustable portion of this range, covering the actual commutations, the rotor together with additional resistance is short-circuited, thus enabling the E.M.F. across the resistor to suffer no interruption but to supply instead the extra quantity of electricity absorbed by the rotor,

in virtue of its self-inductance, on establishment of the current through it at each commutation. In this way the two main errors associated with break and self-inductance are set against one another, and neutralization is readily effected by experimental test under conditions in which these errors are magnified.

The apparatus is designed for the accurate and rapid measurement of resistances of approximately one ohm. The rotor has a constant speed of 12·5 revolutions per second, and the maximum mutual inductance of some 20,000 μH permits of fine adjustment within ± 1 per cent. An accuracy of a few parts in one hundred thousand has been attained.

It is hoped to publish complete details of this investigation elsewhere.

Birkbeck College, H. R. Nettleton.
London, E.C.4. Sept. 30.

[1] Ross, *Bull. Bur. Standards*, **5**, 499 (1909). Cf. "Dictionary of Applied Physics", vol. 2, p. 226.

Interfacial Activity of Short-Chain Isomers

It is well known that when two long-chain compounds, stereoisomeric with one another around a double bond, are adsorbed at a surface, they influence the tension there to extents which differ according the the effective chain length. Recent experiments by me have shown that although the thermal agitation of short-chain adsorbate molecules at a water – air interface prevents any appreciable fall in the surface tension of the solvent, orientation of many small molecules does occur at a water – oil interface. In many cases this is sufficiently marked to reveal interesting differences in interfacial activity between short-chain isomeric compounds, of classes not usually regarded as surface active. Further, these differences can be reproduced with an accuracy which enables such measurements to be used as a means of distinguishing between the isomers.

Experiments have been carried out on two stereoisomeric thio-ether compounds of quadricovalent platinum (kindly supplied by Prof. W. Wardlaw). The results shown in Table 1 were obtained by methods previously described[1], and indicate that while the *trans*-compound has no surface activity, the attraction of the benzene phase for the ethyl groups is sufficient to cause appreciable orientation of the *cis*-molecules at the interface.

Further evidence for the surface adsorption of short-chain molecules is furnished by the dibasic acids. The results in Table 2 show that, although maleic and fumaric acids are not sufficiently amphipathic to be surface active, the additional methyl group in mesaconic and citraconic acids separates the hydrophobic and hydrophilic centres of the *cis*-molecule sufficiently for orientation at the interface to occur. Similar well-defined differences can be observed under suitable conditions between *cis* and *trans* forms

Table 1.

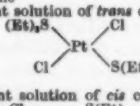
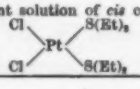
Interface Pure water and :	Interfacial tension (dynes per cm.)
Pure benzene	35·41
1 per cent solution of *trans* compound : 	35·30
1 per cent solution of *cis* compound : 	28·62

Table 2.

Interface Benzene and :	Interfacial tension (dynes per cm.)
Pure water	35·41
1 per cent solution of maleic acid	35·41
1 " " " fumaric "	
1 per cent solution of mesaconic acid (*trans*)	35·41
1 " " " citraconic acid (*cis*)	28·51

of benzaldoxime, and are to be expected with the isomeric diazotates.

Differences in interfacial activity also existing between short-chain *structural* isomers such as the toluic acids, cresols, phthalic acids and butyl alcohols are regarded as additional evidence that interfacial orientation does, in fact, occur in many cases where the adsorbate molecules have been previously considered too small to display any marked amphipathy.

C. C. Addison.

Chemistry Department,
Harris Institute Technical College,
Preston, Lancs.

[1] Powney and Addison, *Trans. Faraday Soc.*, **33**, 1243 (1937); **34**, 356 (1938).

Fibre-Follicle Terminology in the Mammalia

A consideration of recent investigations[1–3] into the early development of the coats and fibres of various breeds of sheep and also of other mammalian types suggests the need for a standard follicle nomenclature. It has been found that the types within the follicle population and their group arrangement in the skin of the fœtus and lamb are among the chief factors which determine what type of staple and fleece will be produced. It is obviously necessary, therefore, to agree upon a consistent terminology if research in this field is to be intelligibly co-ordinated. The accompanying table indicates the present confusion and incorporates our suggestion for a terminology which is simple and, on the basis of our present knowledge, adequate enough to cover all the important follicle types in the mammalian coat.

It is now well established that the basis of the follicle bundle is usually the trio group, that is, a group of three follicles which in the sheep has a special significance in that it produces certain special types of fibres. Other and smaller follicles develop later in association with each trio to complete the follicle bundle. First, then, there are these two clearly defined growth stages, namely: (1) the phase leading to the formation of the trio group; (2) the succeeding or post-trio phase.

In order to make the distinction clear, we suggest that those follicles which are differentiated during the first phase should be termed *primary follicles*, and those comprising the second phase, *secondary follicles*.

All the trio follicles are therefore primary, but in some types it is possible to subdivide the central members of the trios into two categories, namely: (1) those which are differentiated early in the first phase; (2) those which are differentiated later in the first phase.

The earlier and therefore more advanced series of central trio follicles we now term *primary X follicles* and those which belong to the later stages of the first phase, *primary Y follicles*. It is important to add, however, that, at least in the Merino breed, not all primary *X*- or *Y*-follicles become the central members of a trio. Occasionally one remains separate

Follicle Terminology, New and Old

Proposed New Terminology	Duerden (1939)	Gibbs (1938)	Galpin (1935)	Wildman (1932)	Toldt (1911) and Höfer (1914)	Spöttel and Tanzer (1923)
Primary Follicles	= Trio Follicles					
(a) Central trio follicles = primary *X*, primary *Y*	= (a) central trio follicles	= primary follicles, secondary follicles	= *X* follicles, *Y* follicles	primary follicles, secondary follicles	= Mittelhaar follicles	Leithaar follicles
(b) Lateral trio follicles = primary *x*, primary *y*	= (b) lateral trio follicles	= tertiary follicles	= *x* follicles, *y* follicles	lateral trio follicles	Stammhaar follicles	
(c) Couplet follicles = primary *X*+*x*, primary *Y*+*y*						
(d) Solitary follicles = primary *X* or *Y*						
Secondary Follicles	Post-Trio Follicles	Quaternary follicles			Beihaar follicles	Gruppenhaar follicles

and distinct throughout the whole period and may be termed a 'solitary' follicle. A few may become associated during the first phase with only one lateral follicle, and these have been termed 'couplets'.

We are of the opinion that this terminology, whilst it recognizes the follicle types described by other workers, eliminates confusion by clearly distinguishing the follicles characteristic of the two main growth phases which are so important in any consideration of the basis of fleece structure.

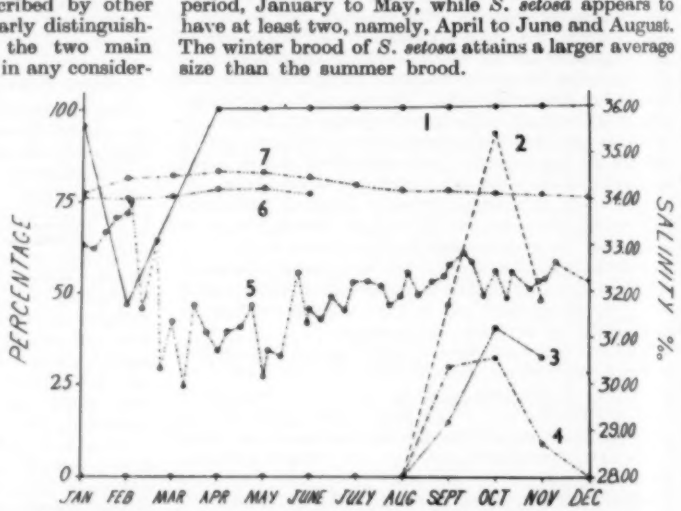
A. B. Wildman.
Wool Industries Research Association,
Headingley, Leeds.
H. B. Carter.
McMaster Animal Health Laboratory,
Glebe, Sydney. Oct. 11.

[1] Duerden, J. F., (posthumous paper), *Trans. Roy. Soc. Edin.*, **59**, Pt. 3, No. 28 (1938–39).
[2] Galpin, N., *J. Agric. Sci.*, **25** (1935).
[3] Gibbs, H. F., *Proc. Zool. Soc. Lond.*, B, **108**, Pt. 3 (1938).
[4] Wildman, A. B., *Proc. Zool. Soc., Lond.*, Pt. 2 (1932).
[5] Carter, H. B., (unpublished), (1939).

Sagitta as an Indicator of Water Movements in the Irish Sea

In a recent study[1] on the occurrence of the planktonic genus Sagitta in weekly collections at Port Erin 1928–37 (excepting 1935) and the Mersey Channel, Morecambe Bay, Anglesey coast 1937, interesting facts have emerged. It seems desirable to give some of the results here pending publication of the whole. Two species are found: *S. elegans* Verrill, the oceanic form[2], is predominant at Port Erin; *S. setosa* J. Muller, the coastal form, is predominant in Liverpool Bay and is recorded here for the first time. *S. elegans* is absent from the Liverpool district until February–March, when an influx occurs correlated with the appearance of high salinities (see graph). *S. setosa* is absent from Port Erin until September–December with a maximum in October (see graph). These interchanges of species occur at about the periods of the equinoctial tides and indicate (*a*) extensive mixing of inshore and offshore waters in the greater volume and movements of the equinoctial tides, and (*b*) the occurrence of relatively stable bodies of water in Liverpool Bay in periods between the equinoxes. The occurrence of relatively stable bodies of water oscillating in estuaries has long been known, but stability in an open bay such as Liverpool Bay is of great interest and worthy of further investigation.

S. elegans appears to have one main spawning period, January to May, while *S. setosa* appears to have at least two, namely, April to June and August. The winter brood of *S. setosa* attains a larger average size than the summer brood.



Percentage *S. setosa* in tow-nettings in the Liverpool District 1937 and at Port Erin 1928–37 (except 1935) are given with salinity readings ‰ at the Bar Lightship (1937) and mean monthly salinities at Port Erin for 1936 and 1937.

S. setosa: 1. Liverpool District 1937; 2. Port Erin 1937; 3. Port Erin 1936; 4. do. 1928–34. Salinity: 5. Bar Lightship 1937; 6. Port Erin 1937; 7. Port Erin 1936

Data on the rates of growth, time of sexual maturity and relative abundance of the two species at different seasons of the year, with a discussion on the sexual cycles, will, it is hoped, be given by one of us (E. L. P.) later.

We are indebted to the Oceanography Department at the University of Liverpool and the staff of the Port Erin Biological Station for the data on salinity.

E. Lowe Pierce.
J. H. Orton.
Department of Zoology,
University of Liverpool.
Sept. 8.

[1] Pierce, E. Lowe, Thesis, Cohen Library, University of Liverpool (1938).
[2] Russell, F. S., *J. Mar. Biol. Assoc.*, **20** (2), 309 (1935).

Sponge Mortality at British Honduras

A HEAVY mortality among commercial sponges, similar to the Bahamas mortality reported by Galtsoff, Brown, Smith and Smith[1], has appeared among sponges off the coast of British Honduras. The disease appeared first in the Bahamas in December 1938, on the north coast of Cuba in February 1939, and at Key West, Florida, in March. Losses were first reported from British Honduras in June and continued to appear during July and August.

Investigations were carried out in British Honduras by me during August and have yielded the following results.

The sponges, for the most part under cultivation, grow upon grounds within Turneffe lagoon, which is enclosed by islands and communicates with the sea by small creeks and larger channels. The sequence of infection, as recorded by Government and private sponge planters, has followed the general trend of water movements within the lagoon. Originating near a large opening from the sea, the mortality spread first to the more open waters to leeward and only later appeared in more deeply embayed areas, and in areas broken up by small cays.

During the months of April, May and June rainfall was less than 25 per cent of the amount recorded in previous years and water temperatures were generally higher. There is evidence that the salinity during June reached very high values, but unfortunately accurate figures are not available. In July and August the conditions of drought, high temperature and salinity were replaced by normal conditions, and in August accurate determinations placed temperature and salinity within the range of observation for previous years, although the mortality remained unchecked.

Examination of plankton collected with 120 mesh per inch silk townet during August showed no unusual constituents or abnormal quantities of the species normally present. In accordance with previous examinations, a general paucity of life was disclosed.

The microplankton was also poor, except for the presence of bacteria, considered to be the food of the sponges. Bacterial examination showed 2,000–30,000 organisms per c.c. in various parts of the lagoon during August. This compared with 2,000–25,000 observed during May.

No unusual mortality was observed among other forms of life in the lagoon. Non-commercial sponges remained unaffected by the disaster.

Microscopic investigation disclosed the presence of fungus-like filaments in the great majority of dying sponges examined. In appearance, spread of infection through the individual sponge, and greater abundance in the transition zone between dead and living tissues, the organism was indistinguishable from that held probably responsible for the Bahamas disease. Apart from the fungal filaments no organisms have been observed other than those characteristically appearing after the onset of decay.

The successive appearance of the mortality at Key West and at Turneffe and the local progress of the mortality along the path of water currents renders it probable that the disease organism was transmitted from Key West to Turneffe by an ocean current. The strong current running counter to the Gulf Stream along the shores of the Gulf of Mexico and the Gulf of Campeche has a velocity varying from 0·5 to 2 knots. The time elapsed between the appearance of sponge damage at Key West and at Turneffe is ample for transmission of the organism by this current.

At the time of writing no further damage has been reported from Turneffe since the middle of August.

F. G. WALTON SMITH.

Sponge Fishery Investigations,
Nassau, N.P., Bahamas.
Sept. 11.

[1] NATURE, 143, 807 (1939).

Transplants of Sea-Island Cotton

WITH regard to the statement made by Prof. Macbride in NATURE of February 4, p. 205, that "the effort to transplant sea-island cotton from islets off the coast of Carolina to other parts of the world has resulted in failure. In a few years the transplanted cotton reverts to the native stock", the following facts, which do not quite support this view, may be of interest.

Sea-island cotton has been grown at the Government Agricultural Farm, Sakrand, Sind, for at least ten years, and the samples raised at this Farm have been regularly tested at this Laboratory since 1929–30. It has been found that in the second year of tests (1930–31) the mean fibre-length dropped from 1·44 in. to 1·25 in., but since then it has remained more or less the same with the exception of 1936–37 when it declined temporarily to 1·18 in. The mean fibre-weight per inch has remained remarkably steady at about $0{\cdot}117 \times 10^{-6}$ oz. From the Farm the cotton spread to the cultivators' fields, and in 1935–36 the area under its cultivation stood at 1,400 acres, giving a crop of about seven hundred bales. Since then the area has decreased sharply, not because of any deterioration in its fibre-properties, but because of its poor yield, which prevented the cultivators from getting adequate monetary return for their labour.

It will thus be seen that at least during the last ten years it has not reverted, when grown in Sind, to the native stock, which is a *neglectum* type having a mean fibre-length of about 0·70 in. and a fibre-weight per inch of about $0{\cdot}300 \times 10^{-6}$ oz., that is, nearly half as long and three times as coarse in staple as the Sind sea-island cotton. Its yield, however, has not been satisfactory, and it may be said to have failed on that account.

NAZIR AHMAD.

Cotton Technological Laboratory,
Matunga, Bombay.
Sept. 1.

Myzus ornatus a Vector of Potato Viruses

TOWARDS the end of 1932, aphids later identified as *Myzus ornatus*[1] were found feeding on clover plants in a glasshouse at the Agricultural College, Glasnevin. The species has since been recorded on a wide host range which includes potatoes, a fact which prompted the carrying out of tests to ascertain the efficiency of this species as a vector of potato viruses.

It was used in three separate trials as a vector of leaf roll, and the results showed that out of sixteen healthy potato plants colonized with *Myzus ornatus* from a leaf roll source, ten developed leaf roll. In two trials as a vector of virus Y, five out of sixteen healthy potato plants became infected with this virus. Negative results have so far been obtained in trials with viruses X and A.

Myzus ornatus has been found to only a very slight extent feeding on field crops of potatoes in Eire, consequently it is probable that it is not important as a vector of potato viruses under field conditions. In view of its wide host range and of the above results, and on analogy with *Myzus persicæ*, it is probable that *Myzus ornatus* may act as a vector of viruses of crops other than the potato.

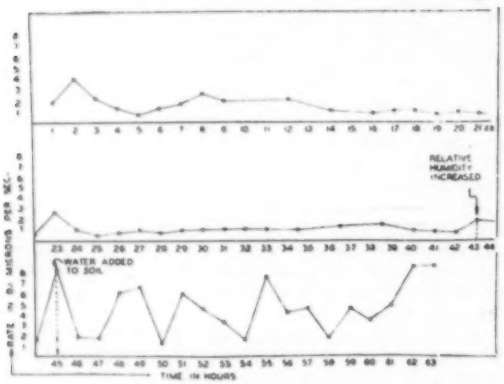
James B. Loughnane.

Albert Agricultural College,
Glasnevin,
Dublin.

[1] Laing, F., "A new Aphid-Pest of Violets", *Ent. Mon. Mag.*, **68**, 52-53 (1932).

Determination of Growth-Rates by the Optical Lever Method

Rhythm was suspected to occur in the growth-rates of seedlings but it could not be detected with the ordinary microscopic methods. The method described here is promising and proved to be accurate and practical.



Rhythm in cell proliferation is habitually retained in spite of certain variations in the periodicity which are induced by changes in the environmental factors. This kind of rhythm cannot be detected directly, but only by means of histological methods. Growth by cell enlargement increases the bulk considerably in a short time, which makes it probable that a sufficiently sensitive method should make it possible to detect rhythm by direct measurement of growth rates, if it exists at all.

There is good reason for thinking that the elaboration of phytohormones of the bios group and that of the phytohormones of the auxin group are correlated. Since the bios factors regulate the process of cell proliferation and the auxin factors regulate cell enlargement, it is probable that rhythm in cell enlargement must exist and that it is correlated to the rhythm observed in cell proliferation. The optical lever method should yield satisfactory evidence of rhythm if it exists.

The optical lever method offers several advantages over the microscopic methods. It is not necessary to mark the seedling; the seedling need not be disturbed during the period of observation; the seedling need not be exposed to light; the factors influencing the growth-rate may be controlled during the observation; the scale reading varies constantly with the growth and may be recorded at any time; the sensitivity may be increased beyond the limits possible in the microscopic method. In the set-up which we employed in recent experiments the direct reading was 0·002 mm.

A galvanometer mirror was mounted on the balance wheel of a watch movement. It reflected a beam of light, coming from a scale, which turned through an angle that was twice as great as the angle through which the wheel turned. The beam was observed through a telescope, where the scale was read with the aid of a reticule. A light glass arm was mounted on the wheel and had a small bead on the distal end. The movement of the growing point turned the wheel. Friction at the point of contact was slight, and in the jewel bearings of the wheel, negligible. The moment of inertia of the system was small. A force of 5 mgm. applied at the bead was sufficient to raise the lever arm. If the wheel was turned through an angle that was greater than was permitted to obtain accurate results, the scale reading was automatically thrown out of view. The elevation of the arm produced by growth was easily compensated by means of a rack and pinion adjustment mounted on the standard which carried the system. Without this arrangement the optical lever method would not be practical.

The displacement of the bead is determined from the formula:

$$E = \frac{pp'}{2D} \times L,$$

in which E is the displacement; pp' the difference in consecutive scale readings; L the length of the lever arm and D the distance from the scale to the mirror.

D was determined directly and found to be 4456·0 mm. L was determined approximately with callipers at first and then precisely by using the formula, but determining E with a measuring microscope. It was found to be 20·50 mm. By actual trials the probable error for our set-up was found to be less than 0·2 microns.

The seedling was placed on an adjustable stand which made it possible to bring the growing point into contact with the bead without disturbing the set-up, which was adjusted so that readings could be taken immediately after contact was made. This feature is of practical importance in the method.

The seedling was kept in a chamber which had an adjustable side. This side had a small aperture through which the beam of light could go to and from the mirror. The chamber made it possible to control the light, the temperature and the relative humidity.

One example will suffice to illustrate the method. The seedling grew in a substratum of peat and sand. It was watered with standard Knop solution at the time of planting and not again except forty-five hours after recording had begun. Seventy-two hours after planting, when the hypocotyl was just emerging from the soil, contact was made between the hypocotyl and the bead. The temperature was 72° F. throughout the period of the experiment; the relative humidity was 90 per cent before the recording began, 70 per cent for the first forty-three hours of recording and 95 per cent for the remaining hours.

The growth-rate is given graphically in the accompanying figure. It increased somewhat with the relative humidity and the increment could be noted after six minutes. The addition of water to the soil increased the rate very much, which was noted one

and one half minutes after watering, and made the periodicity much more pronounced.

The plant never ceased growing. The periodicity was evident before and after the changes in the environmental conditions. The average value of the growth-rate was calculated for each hour of the three cycles. From the values obtained, the general average rate of growth was obtained and found to be 1·092 mm. per hour. Employing this value the calculated final height was 6·8 cm. By actual measurement it was found to be 6·4 cm. The evidence justifies the conclusion that the method is accurate and practical.

William A. Beck.

Institutum Divi Thomae,
Athenæum of Ohio,
Mount Washington,
Cincinnati.
Sept. 7.

Flavin-Adenine-Dinucleotide in Tissues of Rats on Diet Deficient in Flavin

Ochoa and Peters[1] found cocarboxylase decreased in tissues of pigeons fed on a diet deficient in vitamin B_1. Axelrod and Elvehjem[2] reported a diminution of cozymase in tissues of animals on a nicotinic acid free diet. We now find a similar diminution in the flavin-adenine-dinucleotide content of boiled extracts of tissues from rats fed on a diet deficient in flavin. The rats (average weight 35 gm.) were fed a synthetic diet of rice starch, casein (alcohol extracted), salt mixture, supplemented by cod liver oil, crystalline vitamin B_1 hydrochloride, a 50 per cent alcohol yeast concentrate[3], and a liver filtrate from a previous fuller's earth and franconite adsorption. These supplements were flavin-free.

Mean flavin-adenine-dinucleotide content of rat tissues (expressed in μ gm./gm. fresh tissue).

Group	Diet	No. of animals	Mean weight increase (gm. ± 2 × S.E. mean)	Tissue	Mean nucleotide (± 2 × S.E. mean)
A	Flavin deficient	6	14·9±4·0	Brain	10·5±0·6
				Heart	38·0±5·0
				Kidney	72·4±11·0
				Liver	40·7±10·0
B	Flavin deficient plus 50 μ gm. flavin per day	6	79·8±14·0	Brain	13·0±2·2
				Heart	93·2±17·9
				Kidney	78·6±12·5
				Liver	87·3±22·2

The nucleotide was determined after the method of Warburg and Christian[4], and solutions standardized from a pure specimen kindly sent by Prof. O. Warburg. Group A, fed the above diet for 5 weeks, increased in weight but slightly (see table), while Group B, receiving in addition 50 µgm. flavin per day, had a normal growth rate. Some rats in Group A showed a dermatitis, especially around the eyes, and others (results not recorded in table) died before the conclusion of the experiment. It is seen that the mean flavin-adenine-dinucleotide values of Group A are all lower than those of Group B. This is especially so in the case of heart and liver tissue. Application of Fisher's t test to the difference of means of the heart and liver figures gives $t = 6·1$ and $3·81$ respectively. For $P = 0·01$, $t = 3·17$. These figures are thus clearly significant, and afford direct evidence of a further instance of a deficiency in the vitamin B complex affecting biological oxidation systems.

These results will be reported in detail elsewhere.

We are indebted to the Nuffield Trustees and the Hildebrand Harmsworth Trustees (Merton College) for financial support.

Note added in proof. In a letter which has just appeared (Nature, **144**, 670; 1939) Axelrod, Sober and Elvehjem report a decrease of *d*-amino-acid oxidase in kidney and liver of rats fed on a flavin-deficient diet, suggesting a deficiency of its coenzyme. Our own independent results furnish the direct proof of this.

S. Ochoa.
R. J. Rossiter.

Department of Biochemistry,
Oxford.
Sept. 18.

[1] Ochoa and Peters, *Biochem. J.*, **32**, 1501 (1938).
[2] Axelrod and Elvehjem, Nature, **143**, 281 (1939).
[3] Kinnersley, O'Brien, Peters and Reader, *Biochem. J.*, **27**, 225 (1933).
[4] Warburg and Christian, *Biochem. Z.*, **293**, 150 (1938).

Mechanism of Decomposition of Hydrogen Peroxide by Catalase

We have recently suggested[1] that the decomposition of hydrogen peroxide by catalase is brought about by the successive reduction of the catalase iron by the peroxide and its re-oxidation by molecular oxygen; the reaction proceeding according to the following equations:

$$4Fe^{\cdot\cdot\cdot} + 2H_2O_2 = 4H^{\cdot} + 2O_2$$
$$4Fe^{\cdot\cdot} + 4H^{\cdot} + O_2 = 4Fe^{\cdot\cdot\cdot} + 2H_2O$$
$$2H_2O_2 = 2H_2O + O_2$$

The evidence supporting this suggestion can be summarized as follows:

(1) It can be shown spectroscopically that the trivalent iron of azide- or hydroxylamine-catalase is rapidly reduced by hydrogen peroxide, although a powerful reducing agent such as sodium hyposulphite reduces neither the free catalase nor its azide or hydroxylamine derivatives.

(2) The reduced azide- or hydroxylamine-catalase is readily re-oxidized by molecular oxygen but not by hydrogen peroxide or potassium ferricyanide[2].

(3) It has been demonstrated manometrically that the complete removal of oxygen inhibits the catalytic activity of the enzyme by at least 88 per cent in acid phosphate solution and only by 40–70 per cent in a more alkaline phosphate buffer solution. The remaining activity of the enzyme in these experiments is due to a slow non-enzymic decomposition of hydrogen peroxide, which increases with the *p*H, and which liberates a sufficient amount of oxygen to promote the catalytic activity of the enzyme[1].

In our oxygen-free manometric experiments, strong or even complete inhibition of catalase was obtained only when the non-enzymic decomposition of hydrogen peroxide was almost completely abolished. The formation of oxygen during the experiments from non-catalytic decomposition must be avoided because, according to the cyclic mechanism of decomposition proposed by us, the slightest trace of oxygen can, by initiating a series of oxidations and reductions, bring about an extensive decomposition of hydrogen peroxide limited only by the stability of the enzyme preparation. The experiments, therefore, had to be carried out in absence of impurities containing other catalytic metals or hæmatin compounds, at a low *p*H, in thoroughly cleaned flasks and using purified

reagents. Moreover, the small amount of oxygen evolved from hydrogen peroxide even under these conditions was rapidly eliminated from the solution by shaking it vigorously in a thin layer.

Our results have been challenged, however, by Johnson and Schouvenburg[3], who claim to have been able to demonstrate that the catalytic decomposition of hydrogen peroxide by catalase may take place in the complete absence of molecular oxygen. Their evidence is derived from a qualitative experiment showing that hydrogen peroxide added under strictly anærobic conditions to luminous bacteria is decomposed by the catalase of these bacteria. The liberation of oxygen is shown by the appearance of luminescence in these bacteria, which was previously extinguished owing to the complete absence of oxygen. These experiments have been carried out with catalase of living and lysed bacteria, naturally in the presence of a great many of other intra- and extra-cellular catalysts and in strong buffer solutions at *p*H 7·3; in other words, under experimental conditions, which, as we have clearly shown in our paper[1], would reveal only a partial or even no inhibition at all of the activity of catalase.

On the other hand, if we assume that the catalase in their experiments was strongly (90 per cent) inhibited, which is very improbable, the remaining catalytic activity would liberate a sufficient amount of oxygen to induce luminescence in their bacteria.

We can say in conclusion that their experiments, far from disproving our results, show only that the qualitative tests with luminescent bacteria are of very little use in the study of this problem, for which reliable and strictly quantitative methods are already available.

D. KEILIN.
E. F. HARTREE.

Molteno Institute,
University,
Cambridge.
Oct. 13.

[1] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **124**, 397 (1938).
[2] Keilin, D., and Hartree, E. F., *Proc. Roy. Soc.*, B, **121**, 173 (1936).
[3] Johnson, F. H., and van Schouvenburg, NATURE, **144**, 634 (1939).

Tables for Statisticians

IN my review of "Statistical Tables", by Fisher and Yates (NATURE, September 23, p. 533), I referred to the "interesting innovation of providing mean differences for half the interval only". DR. L. J. Comrie has pointed out to me that this practice is followed in E. V. Huntington's "Four Place Tables of Logarithms and Trigonometric Functions", and I gladly take the opportunity of acknowledging this fact.

J. WISHART.

School of Agriculture,
Cambridge.

Points from Foregoing Letters

THE intensity of vertically directed mesotrons at different heights in the atmosphere has been measured by E. G. Dymond in a series of balloon flights. It is found that the intensity rises to a maximum of nine times the ground level value at an air pressure of about 80 mm. mercury. In order to bring the theoretical intensity variations, derived by Euler and Heisenberg, into agreement with these experimental results, it is suggested that there is a minimum energy of formation of mesotrons in the upper atmosphere, of about 8×10^8 ev.

H. R. Nettleton records the conclusion of a series of researches on the absolute measurement of electrical resistance by the development of a method which utilizes the average E.M.F. of a commutating generator. He describes how difficulties associated with the method have been overcome, and states that resistances of approximately an ohm can be measured rapidly with an accuracy of a few parts in a hundred thousand.

C. C. Addison finds some interesting differences in interfacial activity between short-chain isomeric compounds of classes not previously regarded as surface active. Interfacial tension measurements may be used to differentiate between such structural or stereoisomeric compounds.

A. B. Wildman and H. B. Carter indicate the present confusion in the terminology of fibre-follicles in the Mammalia. They suggest a new terminology which recognizes clearly two main growth phases and which should make possible a more intelligible co-ordination of research on the development of the mammalian coat.

E. Lowe Pierce and J. H. Orton find that *Sagitta elegans* is predominant or exclusively present at Port Erin and *S. setosa* in Liverpool Bay, except during equinoctial tides when interchange of species occurs. It is inferred that extensive mixing of inshore and offshore waters occurs at equinoctial tides and that at other periods a relatively stable body of water exists in Liverpool Bay.

Mortality among sponges off the coast of British Honduras is reported by F. G. Walton Smith. Evidence is given to show that the probable cause is identical with that of the recent Bahamas mortality; the time and place of appearance support the suggestion that the disease has been transmitted by ocean currents.

The aphid *Myzus ornatus* is found by J. B. Loughnane to be a vector of certain potato viruses. In view of this ability and of its wide host range, it is suggested that this species may act as a vector of viruses of plants other than the potato.

S. Ochoa and R. J. Rossiter report a decrease of the flavin-adenine-dinucleotide of Warburg and Christian in the heart and liver of rats fed on a flavin-deficient diet, providing another instance of a deficiency of the vitamin B complex affecting a biological oxidation system.

D. Keilin and E. F. Hartree find that the decomposition of hydrogen peroxide by catalase is brought about by the successive reduction of the catalase iron by the peroxide and its reoxidation by the molecular oxygen. This is in contradiction to the view of Johnson and Schouvenberg, which was based on qualitative tests with luminous bacteria.

RESEARCH ITEMS

'Hermanation'

'HERMANATION', Hanns Weltzel explains (*J. Gypsy Lore Soc.*, Ser. 3, 18, 4; 1939), is derived by the gypsies of Germany from the German 'harmonieren', in the sense of 'getting on well with'. If this is correct, it is remarkable that the *Sinti* should have adopted a German term for so characteristic and ancient an institution. It is centuries old among German gypsies or rather among *Sinti* only. It is the basic principle in the structure of their unity. It is the union of a small group of gypsies, in which the number of families is not limited, and the leader is not a chief, but a 'dispenser of justice', or 'judge'. The Hermanation also applies to a definite localized group. Most of the gypsies of central Germany belong to one. The 'Kartepoor' is so called from the beautiful tail feather of the moor-cock, which hunters often wear in their hat. Members of one Hermanation would not eat with those belonging to another. Sometimes the term is used as a synonym for a meeting, when it is equivalent to *Teillu*, the gathering at which matters concerning gypsy law are discussed, and marriages, dispensations of justice, cases of outlawry, and the like are settled. From this it follows that Hermanation denotes a grouping of families which, on the basis of a bond of relationship, subjects itself to its senior member and his colleagues in matters of definite custom. The 'judge', who was in no sense a 'chief' or 'king', had to be a person of reputation and unblemished character (in the gypsy sense), of imposing appearance, and of pure gypsy blood. Supplementary information concerns ceremonial purity, in which taboos relating to women are stressed: for example, the sole of a woman's shoe renders things unclean, and hence it is never mended; while among the Krauses a woman carrying a jug or bucket must hold it away from her body.

Bunas of Bengal

ON various occasions in 1933–35, Minendra Nath Basu carried out investigations of the physical, social and cultural peculiarities of the Buna colonies in Bengal (*J. Department of Letters*, Univ. of Calcutta, 32, 1939). The Bunas are an aboriginal people of Bengal, probably immigrants from Chota Nagpur, attracted by the demand for 'landless' labour. Buna is a name given them as a 'wild' people, though there are other interpretations. In the villages they live in separate areas; and the statement that they are hated by Hindu and Mahommedan alike on account of their fondness for fowl and pork is correct; but nevertheless a large amount of intermixture with the two communities has taken place. Anthropometric measurements and observations of 220 subjects show skin colour (unexposed) varying from tawny white to dark; hair wavy, but with 1·5 per cent woolly; in colour, black, dark brown or grey. Eye slit horizontal, or straight; eye-colour dark brown, 65 per cent, with medium and light brown as variants. The nose is generally straight, though convex noses occur; no alveolar prognathism, and facial prognathism slight; lips medium, 85 per cent without eversion; the chin is prominent; and the body musculature is marked. The following are the percentages for: (1) stature, male, ranging from 130·0 (very short) to 179·9 (tall); the highest percentage is 82·5 in the group 150·0–159·0, the next highest percentage being 9·5 in the group 160·0–169·9; females, range 140 (short) to 152·9 (below medium), 65 per cent being in the group 140·0–149·9; (2) cephalic index, males, dolichocephalic, 41 per cent, mesocephalic, 54 per cent, brachycephalic, 5 per cent; females, 40 per cent, 20 per cent, and 40 per cent respectively; nasal index, males, leptorrhine 26 per cent, mesorrhine 70·5, platyrrhine 3·5; females, 5 per cent, 80 per cent and 15 per cent respectively. On analysis it appears that the Bunas are a highly mixed group, of which the basic stock was probably indigenous to Chota Nagpur, but which afterwards intermixed freely with the peoples of Bengal, Brahmans, Kayasthas, and Namasudras, and lower Hindu castes.

Blood Groups in Africa

DR. R. ELSDEN-DREW has described the results of an investigation into the distribution of blood groups among African natives (*Pub. S. African Inst. Med. Res.*, 44, Johannesburg, 1939). Tribes were examined over a wide area in Southern Rhodesia, Nyasaland, Tanganyika, Kenya and Uganda, and a number of blood specimens were collected and examined in the field. Considerable differences exist between the peoples investigated, for the percentage of the *O*-group varies from 41 in the Lango to 74 in the Ndau; the percentage of the *B*-group ranges from 5 in the Gogo to 31 in the Ankonde, while the *A*-group ranges from 13 in the Ndau to 32 in the Akamba. The significance of the ethnological distribution of the blood groups is discussed, and it is suggested that the Bantu did not descend from the Negro, but are rather a purer example of a common stock, and that the migration on the west coast has been from east to west rather than in the contrary direction. The Bush people are shown to be less 'ancient' than are the Bantu, and an Egyptian origin is suggested for the Hottentot. The technique employed is described, the findings are subjected to statistical examination, and tables are given of the calculated gene frequencies.

Employment Tests for Rayon Factory Hands

Sigemi H. Kirihara and Kazuo Nakamura (Report No. 41. Japan Institute for Science of Labour) carried out a study to see what relation there was between mental characteristics and efficiency in the operatives of a rayon factory. The ages of the workers ranged from 14 to 18 years. An intelligence test and various performance tests were given to the workers on a number of processes, and the results of the tests were correlated both with the quality and quantity of the output. Intelligence apparently plays a negligible part in success in all processes with the exception of 'reeling'; this process gives a positive correlation with all the tests whereas the others give either negative or insignificant correlations. Taking the results at their face value, the use of tests would not give a better selection than the more usual methods. The writers, however, do not give an adequate account of their method, and although they indicate that motion studies were attempted, they do not make it clear whether the results of such studies guided them in their choice of tests.

A Pleistocene Bird's Egg

Eggs are rarely found in fossil deposits, so that the discovery of a bird's egg on the east slope of Lone Mountain, Nevada, in a deposit attributed to Pleistocene times, deserves notice. Alexander Wetmore states that the egg, of which only one half has been preserved, is embedded in dendritic tufa, having apparently been deposited in water beneath a cone of that material in which it afterwards became involved (*Condor*, **41**, 98; 1939). It measures about 63 mm. in length and 38·5 mm. in width; the shell is pale olive buff in colour on the outer surface and its surface bears irregularly scattered pits. Although no identification is claimed, the author states that comparison with modern eggs suggests that the fossil egg comes closest to the egg of a cormorant.

Jungle Yellow Fever and other Diseases

Important studies on jungle yellow fever in Brazil are described in the annual report for 1938 of the International Health Division of the Rockefeller Foundation, recently published. Jungle yellow fever differs from the classical variety of yellow fever in that it is not conveyed by the mosquito, *Ædes ægypti*. As a result of much research, it seems probable that certain monkeys may be reservoirs of jungle yellow fever, infection from which may be transmitted to man by two species of mosquito. Preventive vaccination with a particular strain of virus has been extensively pursued, more than a million persons having been inoculated, but it is too soon to state with what amount of success. Malaria, influenza, tuberculosis, and worm and other diseases have also been the subjects of study. Details are given upon finance, and of grants made to various bodies, schools and individuals.

A Trypanosome in a Tigress

Parasitic trypanosomes are found in the blood and tissues of various kinds of vertebrates, sometimes causing important diseases in animals, for example, in the horse, and the African sleeping sickness in man. They are, however, rarely found in carnivorous animals, and the record of a trypanosome encountered in a tigress by Dr. Z. Mohamed is therefore of considerable interest (Ministry of Agriculture, Egypt. *Veterinary Service Bull.*, No. 200. Cairo, 1939). The animal came from Sumatra to the Zoological Gardens, Giza, in 1926; it had always been healthy, but became ill on October 18, and died on October 21, 1935. Trypanosomes were found in the blood in large numbers; cultures were failures, but inoculations into dogs, rabbits, rats and guinea pigs proved fatal to these animals in periods of from one to four months. The morphology of this tigress trypanosome is described; it closely resembles that of *Tr. evansi*, which causes surra in camels, but differs from it in some points, and is regarded as a new species, for which the name *Tr. kirdanii* is proposed. The source of the infection in the tigress was not discovered.

Toxicity of certain Insecticides

G. R. Cameron and Cecile R. Doniger have carried out toxicity experiments on mice, rats, guinea pigs and rabbits with lauryl thiocyanate and *n*-butyl-carbitol-thiocyanate (in the form of lethane 384). These agents are now being employed as contact insecticides in the campaign against the bed-bug. In field-work, they are diluted, usually with kerosene, to about 1 : 64 for the first-named, and 1 : 40 for lethane. Methods of exposure included contact in miniature houses sprayed with the undiluted and diluted liquids, skin applications, oral administration and injections. Both compounds cause death of the experimental animals on injection, but in dilutions similar to those used in field work have produced no ill effects, and in such dilutions are unlikely to be dangerous to human beings. Undiluted lauryl thiocyanate causes severe local reaction when applied to the skin, lethane only a slight reaction. The skin should, therefore, be protected when handling the undiluted substances (*J. Path. and Bact.*, **49**, 363; 1939).

Effect of Temperature on Chromosomes affected by X-rays

K. Sax and E. V. Enzmann (*Proc. Nat. Acad. Sci.*, **25**, 397–405; 1939) have analysed the effect of temperature upon aberrations induced by X-rays on the chromosomes of Tradescantia microspores. Except for earliest prophase, it is found that X-rays induce considerably more breaks at 3° C. than at 38° C. There is a critical temperature above which the number of observed breaks is much reduced, but this critical temperature varies with the season. The authors consider that X-rays induce a similar number of breaks at low and at high temperature, but at high temperatures the reunion of ends is accelerated; therefore the reunion of the original breakage points may take place. Misalignment may occur through the slowness of reunion at low temperatures. The reverse temperature effect at earliest prophase is difficult to explain, but may be due to similar causes to those underlying the phenomena of chiasma formation, which also occurs at this stage.

Analyses of Commercial Coals

A report on the analysis of commercial grades of coal produced in the Nottinghamshire and Derbyshire area has just been published (Summary of Fuel Research Survey Paper No. 48. London: H.M. Stationery Office. 3*s*.). The report forms part of the general survey of the national coal resources which is now being carried out, and is the second to deal with commercial sampling in this area. It presents the results of the analysis of 277 grades of coal from seventeen collieries. The work of the survey proceeds along two parallel lines. The first deals with the seams as they occur below ground. The coal from the seams, however, is passed through many processes of blending, cleaning and grading before being marketed. The second line of investigation is therefore to sample and analyse the actual products of the collieries, so that information may be available regarding the types of coal actually obtainable by consumers. The present report is confined to work of the second kind and deals with such types as varieties for the manufacture of metallurgical coke, high-grade house and gas coals, locomotive and bunker fuels, and free-burning coals for steam raising and general industrial purposes. At each colliery visited, all the grades finding a commercial outlet were sampled and analysed. Against the recognized commercial name of each grade are given the screen size and description, including the method of preparation, use and seam of origin. These data are followed by the analyses. The report also includes a discussion of the variability of the grades and of the methods by which they are prepared.

Ground Vibrations near Dynamite Blasts

This has been the subject of investigation by L. Don Leet (*Bull. Seis. Soc. Amer.*, **29**, No. 3, 487; July 1939), who has examined in detail the records of such quarry blasts obtained on a portable three-component seismograph. He found that high-frequency vibrations (25–50) of short duration (about 0·5 sec.) were typical of records on rock, whilst lower frequencies (3–5) and longer duration (max. 23 sec.) were recorded on unconsolidated earth fill, particularly if it exceeded about 20 ft. in thickness. Among the chief types of vibration, Rayleigh waves, Love waves and a new (observationally) *C*-type wave were generally observed. The average period of the Rayleigh waves was 0·14 sec., the velocity of the front of the group about 1,000 ft./sec., and the velocity of the centre of energy about 800 ft./sec. The period of the Love waves was about 0·15 sec., and the beginning of the group corresponded roughly with the equation $t = 0{\cdot}340 + \frac{\Delta}{2180}$, with t in seconds and Δ in feet. The third type of surface wave, called *C*, was characterized by motion on all three components, with maximum displacements in phase, a pull-down-left followed by a push-up-right or other similar combination. It most nearly resembled one of the theoretical coupled waves of Uller. The apparent beginning of the *C* wave approximately fitted the travel-time equation $t = 0{\cdot}100 + \frac{\Delta}{2960}$ (ft. sec. units). Its period may have been 0·18 sec., but irregularity of form made the measurement uncertain. Some or all of these types of waves could be identified on the records examined by Leet, and their separation by velocity differences was undoubtedly a basic factor in the rapid diminution of the initial amplitudes with distance. It was observed that the detailed manner in which this occurred was unique for every location, depending on local formations and velocities, but the range of amplitudes for various distances and sizes of charge could be predicted within limits which were narrow enough to be of practical engineering value in estimating probable effects on structures. Maximum amplitudes at distances greater than a few hundred feet from the shots reported (typically 60 per cent and 75 per cent quarry gelatin loaded in three holes 6 in. diameter and 140 ft. deep) did not exceed ½ and were often less than 1/100 those found necessary to cause initial damage to plaster in a test house subjected to increasingly severe vibrations until damage occurred.

Weather Periodicities in Turkestan

Periodicities in weather observed in Turkestan and on the eastern shore of the Black Sea (V. A. Blagoveschensky, *Piroda*, No. 6; 1939) would appear to coincide with the 20-day period of variation which has been found to exist in the solar constant (cf. Abbot, Nature, **143**, 705–709; 1939). While investigating the periodicities in daily minimum temperatures, Blagoveschensky discovered in them a master cycle, lasting, on the average, 18 ± 2 days, with a sharp fall maintained for 3–4 days at the beginning of each period, followed by a gradual increase until a new period is initiated by another fall. The master cycle may be interrupted on the ninth or tenth day by a fall, initiating another temperature wave. These waves occur throughout the year, and the summation of minimum temperatures within them shows that there is a more or less regular alternation of relatively warm and cold cycles. They appear to be determined by the passages of families of major and secondary cyclones arriving from the north.

Salts of Europium

Although the rare-earth element europium was characterized by Demarçay in 1900, its compounds have been little studied. H. N. McCoy (*J. Amer. Chem. Soc.*, **61**, 2455; 1939) has examined some salts with different results from previous workers. The *m*-nitrobenzenesulphonate crystallizes with 6 (not 3) H_2O, the citrate with 4 (not 5) H_2O and the iodate with 4 (not 5½) H_2O. A number of other europic salts with organic acids, mostly with water of crystallization, were analysed. Europous salts are quickly oxidized by air when they are soluble, but the sulphate, $EuSO_4$, was found to be stable and to suffer little change in a year. An improved titration method is described.

Total Solar Eclipse Results of June 8, 1937

In "Solar Eclipse Series" No. 1 of the publications of the National Geographic Society (Washington) are described by several specialists the observations of the total solar eclipse of June 8, 1937, made from Canton Island, a small atoll in the Phœnix Islands, by the joint expedition of the National Geographic Society and the United States Navy. The observation of this eclipse presented unusual difficulties, because the path of totality was confined almost wholly to the Pacific Ocean, but the duration of totality, which exceeded 7 minutes—the longest since the year 699—was an incentive to the projected expedition, although no land site was near the position of longest totality. The expedition had perfect weather for the eclipse. The corona was of maximum type according to expectation, the maximum of the 11-year solar cycle occurring in that year. Photographs of the corona were obtained with a special rotating sector disk in the optical train in order that the exposures might be more nearly equalized for the inner and outer parts of the corona. A long streamer was recorded up to a distance of 5 million miles from the sun's limb. The total light of the corona was also determined, and as in most previous eclipses was about equal to half the intensity of the full moon, or one millionth that of full sunlight. A study of the polarization of the coronal light was made, and it was found that the percentage of polarization of the corona and its streamers increased outwards from the sun. The inner corona was also photographed by colour processes (giving a beautiful reproduction in the text). To obtain colour separation negatives, each plate carried its own gelatine colour-filter on the opposite face to the photographic emulsion. A colour painting was also made and is a useful record of the full extent of the corona as seen by the eye. In the study of the spectrum of the chromosphere and of the corona, a new emission line at λ 4412 was detected and appears to be a genuine coronal line. Valuable experience was obtained with a Schmidt camera (giving almost perfect definition over a very wide field) and aluminized plane gratings as applied to eclipse problems. The progress of the eclipse was described from the eclipse camp in a radio broadcast arranged by the National Broadcasting Company of the United States, the radio transmitter being installed on the *Avocet*, the ship which brought the expedition from Honolulu to Canton Island.

THE TEACHING OF MECHANICS

AMONG the many functions which had to be cancelled when hostilities broke out between Germany and Poland was a discussion, due to be held by the British Association at Dundee on September 2, on "The Teaching of Mechanics". This subject holds a peculiar position in the curriculum, lying as it does in the region between physics and mathematics, and having the character both of a severely academic subject and of a cultural one.

The opener would have been Prof. E. A. Milne, who proposed to consider the teaching of the subject to schoolboys, undergraduates, and research workers in turn; in the first stage, experiment should be dominant. It is not surprising, in view of Prof. Milne's own work and experience, that he should suggest that in the third stage, the tacit assumptions of the existence of rigid bodies and of the uniform flow of time should be subjected to criticism. He also offers the suggestion that the logical unsatisfactoriness of quantum mechanics may be due to want of interest in the foundations of mechanics among those who work on the subject.

With Prof. Milne's views we may compare those of Prof. R. Peierls, who was to have been the closing speaker, and who remarked to the present writer that he was sufficiently new to the task of teaching mechanics to feel an interest in its problems and technique. He finds it difficult to steer a true course between the Scylla of special examples and the Charybdis of general theorems, and he feels also that 'statics-and-dynamics' takes up too much time, to the exclusion of elasticity, hydrodynamics and even electricity and optics. On detailed points, he would like to see more use made of dimensional arguments, and the asymptotic solutions of problems (a plea which the writer heartily supports), whilst Prof. Milne stresses in particular the value of vectorial methods as developed by S. Chapman.

The two papers to have been given between these were both by teachers in schools. Mr. K. S. Snell, of Harrow, feels that in the general introduction, to be taken by all boys, experiment should be fundamental, and the appeal to phenomena of daily life should be frequent. This introduction would thus satisfy those who demand cultural value in the subject. For the other course, to be taken afterwards by boys who intend to specialize in science subjects, Mr. Snell feels that the order should be reversed, the subject being developed mathematically, and the deductions checked by experiment. This is, of course, the line followed in much of the historical development of the subject, and allows far fewer principles to be used than the alternative method where experiment is made basic at each step.

It was fitting that at a meeting held in Dundee one of the speakers should represent Scottish schools, and this role was filled by Dr. G. P. Tarrant, of Edinburgh, who, in addition to suggesting methods of teaching, had some specific grievances to mention. He points out that the content of Scottish education has failed to adapt itself to the modern world as rapidly as has that of England. Science there is still tolerated rather than encouraged, so that in the Higher Certificate examinations, Latin or geography or history or book-keeping or art is a whole subject, but physics or chemistry or biology is a half subject. Naturally the school course is designed to meet the examination requirements, and it becomes necessary to teach 'electricity' without mentioning electromagnetic induction, motors or moving-coil instruments and thereby deprives the subject of any value to the boy who does not specialize later. In mechanics itself, the syllabus omits the laws of momentum or any consideration of rotation, and even excludes simple harmonic motion from its consideration of kinematics. In fact, the Scottish pupil does about half the science subjects, and does each of them about half as thoroughly as the English pupil. Hence part of Dr. Tarrant's address would have been devoted to a plea for overhauling the scheme of teaching and examining science subjects in Scotland. The present writer would, however, remark that Scotch engineers are known all over the world as sound and reliable men in general, and therefore that it would seem desirable to consider (*a*) whether mechanics is less important to engineers than teachers believe, or (*b*) whether mechanics can easily be learned later in life, in which case the school syllabus is less important to future specialists than we have assumed.

The other part of Dr. Tarrant's address showed how, in spite of difficulties, mechanics can be made a 'live' subject. By means of Meccano models of roof trusses and the like, problems of moments can be visualized, and the difficulties of three dimensions removed. The same method illustrates the triangle of forces clearly and visually. When the stage of calculation is reached, the human being makes an interesting subject. It requires no difficult mathematics, for example, to show on mechanical principles that the requirements for the high jump are: (1) long legs; (2) powerful swing with the free leg and with the arms, while the take-off leg is still bent; (3) a straightening of the original forward tilt of the body, then a straightening of the take-off leg, and finally a jump with the toe, the whole being so timed that the arms and legs acquire their upward momentum before the lift of the centre of gravity commences, and so that they are brought to rest relative to the body at the exact instant that the toe leaves contact with the ground; (4) a style of crossing the bar which keeps the centre of gravity very low on the bar and the head above the buttocks. Like Prof. Peierls, Dr. Tarrant introduces the dimensional argument, and uses it, for example, to show that a very small animal needs relatively more food than a big one, merely to keep warm, and explains therefore why small animals are not indigenous to the arctic or antarctic regions.

Had the meeting taken place, it was the hope of the organizers that the contributions to the free discussion following these papers would have been not the least valuable part, but it is hoped that the slight outline here given of the contents of some of the papers may at least stimulate those who would have discussed the matter, to consider it again for themselves and perhaps to try out different methods of teaching, the results of which can be reported at a more suitable time.

J. H. AWBERY.

CRITICAL AND CO-OPERATIVE PHENOMENA

IN 1937, Prof. J. E. Lennard-Jones and Dr. A. F. Devonshire published two important papers on "Critical Phenomena in Gases" in which they regarded each atom of a dense assembly, irrespective of physical state, as moving in the field of force of its neighbours and confined by them to a small region of space equal to the mean available volume per atom. The methods and theory of these papers have now been extended in two further papers.

The first[1] deals with a theory of melting and the structure of liquids. From X-ray evidence on liquids it is concluded that there exist regions of order approximating crystallinity, particularly just above the melting point, and from X-ray evidence on alloys it is known that certain types of disorder can occur. It is therefore difficult to differentiate the crystalline solid and liquid states satisfactorily, and this is necessary before any theory of melting can be developed. Assemblies of atoms with spherically symmetrical fields of force probably form 'normal' liquids. In a solid the cell in which an atom moves is localized, whereas in a liquid the motion of an atom must be represented as a vibration about a point which is itself undergoing displacement. Solids are assumed to be alloys of atoms and 'holes'. At low temperatures the atoms occupy all the available sites on a perfect lattice and the 'holes' all the available sites on a similar lattice which interpenetrates the first. The number of atoms occupying abnormal sites gives a measure of the disorder of the assembly. The energy required for the interchange of an atom and a 'hole' is assumed to be a function of the volume of the whole assembly. From these concepts a theory of melting is developed. An equation of state of solid and liquid is also derived which gives values in good agreement with observed values for change in volume on melting, and for the thermal expansions of solid and liquid.

The subject-matter of the second paper[2] is very similar. The method in the former paper is simplified by assuming that the environment of any one atom is governed by the average state of order throughout the assembly, instead of, as in the former paper, taking account only of immediate neighbours of any atom. The equation of state of a disordered assembly, the melting temperature in terms of interatomic forces, and the various phenomena associated with melting are discussed.

[1] *Proc. Roy. Soc.*, A, **169**, 317 (1939).
[2] *Proc. Roy. Soc.*, A, **170**, 464 (1939).

THE ENGINEER AND THE STEELMAKER

IT is of great importance that the steelmaker should know all about his products, so that he may give advice to the engineer as to any of the alloy steels that he manufactures.

Mr. D. Taylor, in the *Journal of the Junior Institution of Engineers* of October, in a paper on "Steel and the Engineer", lays stress on the importance that the steelmaker attaches to providing the most suitable quality of steel for the work which the engineer has in hand. The common sphere of activity linking together the work of engineers and metallurgists is the main subject of the paper.

The author gives some typical examples of a metallurgical and mechanical nature and of wrong handling which leads to failure. He traces what happens to a 'cast' of steel from its initial stages to its final release. The first important stage is selecting the raw materials, the next the method of melting, which governs the cost, and finally the computation of the 'mixes' employed. Five methods of melting are used. The first method is the crucible method, in which the furnace is of simple design and easily controlled. The second is the Siemens open hearth furnace, which produces either acid or basic steel. In the case of acid steel, the bath of metal is worked under an acid slag and so the sulphur and phosphorus are not thereby eliminated and purer materials must be used. In the case of the basic method, the sulphur and phosphorus may be removed almost entirely, while the carbon and manganese content are practically unchanged. The third method is the arc furnace run with a basic hearth. The product is low in sulphur and phosphorus, and this is good from the mechanical point of view. The fourth method is the coreless high-frequency induction furnace. The advantages of this furnace are that there is no contamination of the metal bath, due to fuel; the bath is in constant motion during melting; the melting temperature can be controlled within certain limits and the bath can be refined. Another method used is to employ an open hearth furnace to do the heavy melting, and then to refine the metal in the electric furnace.

The product of the furnace is required either in the form of castings or as ingots. The ingot is a casting of a particular type which is later mechanically worked. It is important that the ingot should be as perfect as possible, otherwise defects will arise at a later date. If it is to be sound, careful control of the casting temperatures must be taken. To produce a perfect ingot the surfaces should be smooth planes with correctly rounded corners. Prior to use, the inner surfaces of the mould are prepared by painting with a special compound. After the metal has been poured into the mould, it commences to freeze in planes parallel to the ingot mould surfaces. During the freezing, any non-metallic matter will, as crystallization proceeds, be rejected and conveyed to the centre of the ingot, which is the last portion to freeze, and is thus trapped. When the steel has solidified and cooled, it can be stripped from the ingot mould. It is immediately marked up with its cast number, which identity it carries throughout the works. Many months after casting, relevant data, such as casting temperature, nature of the ingot skins, etc., of the cast can be readily found by reference. In this way

the steelmaker builds up a personal knowledge and experience of the casting made by various alloys.

If the product of the furnace is required in the form of castings, the casting temperature must have its definite value. In this case its contours are good, the shrinkage is a minimum, the structure is reasonably strong and free from blow holes. The author gives lists of the common defects associated with castings and also defects rising from incorrect treatment or application.

The engineer sometimes produces components which need to be heat-treated. The hardening shop has a great deal of responsibility, as it is the last stage of the work. The steelmaker goes to a great deal of trouble in determining the critical points of his alloys, which can be found from the heating and cooling curves, and from these he computes the best temperatures for hardening. These temperatures must always be used. The pyrometer must be periodically inspected and calibrated. Useful information can often be obtained from the microstructure as seen by microscopic examination of a representative sample by means of a metallurgical microscope.

NUCLEOLI, SATELLITES AND SEX CHROMOSOMES

By Prof. R. Ruggles Gates, F.R.S.

In recent years striking discoveries have been made regarding the origin and history of the nucleolus. It has come to be recognized that in every cell of a plant or animal species there is at least one pair of chromosomes which is specially concerned in producing this body. This pair of chromosomes may have either a satellite or a secondary constriction. In a satellited chromosome the exact point of origin of the nucleolus appears to be the end of the chromosome proper, where the delicate thread or filament arises which attaches the satellite (a tiny globule of chromatin) to the body of the chromosome. This locus has been called the nucleolar organizing body. In the telophase of mitosis each satellited chromosome gives rise to a nucleolus, while in a chromosome with a secondary constriction the nucleolus arises at the constriction.

There are thus in the early telophase of mitosis as many nucleoli as there are chromosomes with satellites or secondary constrictions (the primary constriction being at the spindle fibre attachment). Some chromosomes with a secondary constriction, however, do not produce a nucleolus. By the following prophase the nucleoli have frequently all fused into one. By means of a new stain[1], Feulgen and Light Green, which stains the chromatin (including the thread or filament) red and the nucleoli green, the exact nature of the attachment of nucleolar chromosomes, whether at a satellite thread or a secondary constriction, can easily be determined. The number of chromosomes attached to the nucleolus in prophase is thus the same as the number which produce nucleoli in telophase. This relationship can generally be confirmed by an examination of the chromosomes in metaphase, when the number which have satellites or secondary constrictions can be determined, except in the very smallest chromosomes.

In an ordinary diploid plant or animal species there is thus one pair of chromosomes with satellites, or sometimes with secondary constrictions instead. This difference seems to depend merely on whether the thin portion (thread) of the chromosome is near the end, to produce a satellite, or nearer the middle of the chromosome. In polyploid species the number of *SAT*-chromosomes and telophase nucleoli is correspondingly increased. Thus a tetraploid will have four, and a hexaploid species such as the bread wheats will have six.

Some species, however, which have hitherto been regarded as ordinary diploids, have two pairs of nucleolar chromosomes. Sometimes one of these pairs has satellites and the other pair secondary constrictions. Some of these cases are clearly secondary tetraploids in which a new species or perhaps a new genus has arisen through a change in the basic number of chromosomes. Many such cases have been observed in connexion with recent cytological work. The study of the nucleoli in a species has thus become a method of tracing changes in chromosome number and how they have taken place, in other words, nuclear phylogeny.

As an example, rice may be cited. Cultivated rice, *Oryza sativa*, has twelve pairs of chromosomes. But many varieties have two pairs of nucleolar chromosomes, indicating that it is a secondary tetraploid or an amphidiploid. Further evidence is afforded by the secondary pairing of the chromosomes in the pollen mother cells. Such a pairing of chromosome pairs or bivalents with each other indicates a specific attraction, which is the result of homology.

The bivalent chromosomes arrange themselves in rice so that the maximum association is into two groups of three bivalents and three groups of two bivalents, 2(3) + 3(2) or *AAABBBCCDDEE*, thus making five groups of chromosomes having different homologies. That five is the basic number of chromosomes, from which the twelve in rice has been derived, was confirmed by showing (Ramanujam[2]) that in certain genera related to Oryza, such as Zizania and Lygaeum, the chromosomes were in high multiples of five, while in other genera, such as Hygroryza, they were in multiples of twelve.

Many varieties of rice still have two pairs of *SAT*-chromosomes, and so produce four nucleoli, confirming that they are secondary tetraploids. But it appears that it is only necessary for an organism to have one pair of *SAT*-chromosomes in order for the cells to function. In many varieties of rice only one pair is present. The other pair has been lost, probably by a mutational loss of a satellite from one of the four *SAT*-chromosomes and subsequent inbreeding. Several other wild species of Oryza, both in India and Africa, have doubled their chromosomes and have 24 pairs. They are thus secondary octoploids. This is an example of the way in which the origin and history of a genus can be traced by

investigation of the behaviour of the chromosomes and especially of those which produce nucleoli. There is much other evidence that five is the fundamental chromosome number in the grasses, the family to which rice belongs.

Another recent example may be taken from the leguminous genus Cicer (Iyengar[3]). *C. arietinum* has 16 chromosomes. In prophase four chromosomes are attached to the nucleolus and at meiosis the maximum association is one group of three bivalent chromosomes, two groups of two and a single bivalent, 1(3) + 2(2) + 1 or *AAABBCCD*. This indicates that four different (non-homologous) chromosomes was the original basic number. These observations confirm much other evidence (some of it unpublished) that four is the basic or original number of chromosomes in the family of Leguminosæ, from which all other numbers in this family have been derived.

It is now well known that in groups of organisms as widely separated as insects and liverworts there are generally sex chromosomes, typically a large *X*- and a small *Y*-chromosome. Moreover, these bodies or portions of them are heteropycnotic, that is, they are condensed in prophase when the other chromosomes are still in a diffuse condition. The heteropycnotic portions are believed to be genetically inert.

While the *XY* combination in insects, mammals and some other animals produces a male, in liverworts and mosses the *XY* pair are present in the sporophyte, the male gametophyte having a *Y* and the female gametophyte an *X*, in addition to the remainder of the haploid set of chromosomes.

Recent observations show that in many cases, both in insects and bryophytes, the *X*- and *Y*-chromosomes are attached to the nucleolus, that is, they have a satellite or secondary constriction and are concerned in producing the nucleolus to which they are attached. The possible significance of this widespread condition appears to have been overlooked. Kaufmann[4] has shown that in somatic cells of male *Drosophila melanogaster* the *X* (with a secondary constriction) and the *Y* (with a satellite) are attached in prophase to the nucleolus which they produce. Heitz[5] indicates the same situation not only in *D. melanogaster* but also in *D. funebris*, *D. simulans*, *D. virilis* and *D. Hydei*. By its heteropycnotic condition Heitz identifies the *X*-chromosome as attached to the nucleolus also in *Scatophila unicornis* and in two other genera of insects.

Thus it appears that in these insects the *X*- and *Y*-chromosomes are generally nucleolar chromosomes, the former with a constriction and the latter with a satellite. An exception was found, however, by Kaufmann[6] (1937) in *Drosophila ananassae*, in which the *X* is not nucleolar, but a pair of autosomes (ordinary chromosomes) with satellites are attached to the nucleolus in the female. In the male, however, there are three chromosomes attached to the nucleolus, the *SAT*-pair and the *Y*, which also has a satellite. Kaufmann suggests that this departure from the usual condition has been produced in this species by a translocation between the *X*-chromosome and an autosome.

From a study of the salivary gland nuclei of Drosophila, Frolova[7] finds the nucleolus attached by a branched chromatic thread to the chromo-centre, to which the ends of all the chromosomes are in turn attached. It seems probable that the sex chromosomes have here become detached from the nucleolus which they presumably produced, as in less specialized cells.

In liverworts, Lorbeer[8] (1934) figures a large *X*-chromosome, evidently with a secondary constriction, attached to the nucleolus in *Sphaerocarpus Donnellii*, in the cells of the female thallus. In the cells of the male thallus there is a very small *Y*-chromosome and also an autosome with a satellite. In the spore mother cell there are seven pairs of autosomes together with a large heteropycnotic *X*-chromosome attached to the nucleolus and the very small *Y*, also no doubt attached to the nucleolus when in its natural position. In *S. europaeus* the cells of the male thallus contain a *Y*- and a *SAT*-chromosome, while in the female gametophyte an *X*- and a *SAT*-chromosome are present. In Marchantia, both the *X* and the *Y* are figured attached to the nucleolus. Thus it appears that the sex chromosomes of the liverworts are nucleolus-producing, as in insects, but there are in some species also a pair of autosomes which produce nucleoli.

Allen[9] figures in *Sphaerocarpus cristatus* a heteropycnotic body which is part of the *X*-chromosome, attached to the nucleolus. In the liverworts *Pallavicinia longispina* and *Calobryum rotundifolium*, Tatuno[10] figures a large *X*-chromosome with a secondary constriction and a smaller *V*-shaped *Y*, both being shown attached to the nucleolus in the spore mother cell of Pallavicinia. In *Makinoa crispata*, on the other hand, there are no heteropycnotic (sex) chromosomes, but the cells of the sporophyte show a pair of *SAT*-chromosomes. Tatuno[11], in a further study, shows a large heteropycnotic *X* and a small *Y* in *Pallavicinia Lyelli*, *Riccardia pinguis*, *R. blasioides*, *Pellia Nessiana* and *P. Fabbroniana*. But in both species of Pellia a *SAT*-chromosome is figured during mitosis in both the male spores (which have the *Y*) and the female spores (which have the *X*-chromosome).

In mosses, similar conditions hold. Shimotomai and Koyama[12] (1932) show in the female gametophyte of *Pogonatum inflexum* a large heteropycnotic *X*-chromosome attached to the nucleolus, a small *Y*-chromosome attached in the nucleoli of the male gametophyte, and both attached to the nucleolus in the cells of the seta (sporophyte). Shimotomai and Kimura[13] show similar conditions in Polytrichum and Ceratodon.

Thus it appears that both in insects and bryophytes the sex chromosomes take part, with or without a pair of autosomes, in forming the nucleoli. In dicœcious flowering plants the relation of the *X*- and *Y*-chromosomes to nucleolar production is not yet known. By the use of the new staining method already mentioned, it will be possible to trace their history fully in flowering plants and also to throw further light on the behaviour of the sex chromosomes in other organisms.

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[3] Iyengar, N. K., *Ann. Bot.*, N.S., **3** (1939).
[4] Kaufmann, B. P., *J. Morph.*, **56**, 125–154 (1934).
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[7] Frolova, S. L., *Biol. J.* (Russian), **5**, 271–292 (1936).
[8] Lorbeer, G., *Jahrb. wiss. Bot.*, **80**, 567–818 (1934).
[9] Allen, C. E., *Bot. Gaz.*, **97**, 846–853 (1936).
[10] Tatuno, S., *J. Sci. Hiroshima Univ.*, 1, 165–182 (1933).
[11] Tatuno, S., *J. Sci. Hiroshima Univ.*, **3**, 1–9 (1936). See also *Bot. Mag. Tokyo.*, **51**-**53**.
[12] Shimotomai, N., and Koyama, *J. Sci. Hiroshima Univ.*, Ser. B., Div. 2, **1**. 95–101 (1932).
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SCIENCE NEWS A CENTURY AGO

The Geological Society

At a meeting of the Geological Society, on November 6, 1839, several papers were read, among them being one "On the Relative Ages of the Tertiary and Post-Tertiary Deposits of the Basin of the Clyde" by James Smith; and another paper was "On the Noxious Gases Emitted from the Chalk and Overlying Strata in Sinking Wells near London", by Dr. Mitchell.

The most abundant deleterious gas in the chalk, said Dr. Mitchell, is the carbonic acid, and it is said to occur in greater quantities in the lower than the upper division of the formation. The distribution of it, however, in that portion of the series is very unequal, it having been found to issue in considerable quantities from one stratum, while from those immediately above and beneath none was emitted. Sulphuretted hydrogen and carburetted hydrogen gases sometimes occur where the chalk is covered with sand, and London clay, as well as in other situations. In making the Thames Tunnel they have been both occasionally given out, and some inconvenience has been experienced by the workmen: but in no instance have the effects been fatal. In the districts where sulphuretted hydrogen gas occurs, the discharge increases considerably after long-continued rain, the water forcing it out from the cavities in which it had accumulated. Dr. Mitchell cited several cases of well-diggers having been suffocated from not using proper precautions.

Difference of Longitude between Greenwich and New York

At the Birmingham meeting of the British Association in August, 1839, Edward John Dent (1790–1853), the well-known chronometer maker, gave an account of observations made with four chronometers sent to the United States and back in the S.S. *British Queen* on her first trans-Atlantic passages.

Referring to the use of chronometers, Dent said that "The rapid transmission of chronometers now practicable by means of steam vessels from one meridian to another offers great facilities for the determination of the differences of longitude". On November 8, 1839, he wrote from No. 84, Strand, to the Editor of the *Athenæum* giving particulars of observations made during the second voyage of the ship with a second set of chronometers. By the second experiment the difference of longitude between the observatory at Greenwich and the City Hall, New York, was found to be 4h. 56m. 0·24*s*. west. "The great rapidity and accuracy," said Dent, "with which this important branch of nautical inquiry may be pursued over the whole surface of the globe, as the agency of steam shall be extended, is now, I think, demonstrated. . . . Within the space of ninety-nine days, we have seen the *British Queen* carry chronometers *four* times across the Atlantic, and give ample time during each of her visits to New York for the necessary observations of rates, etc.

"All objections founded on the idea that the motion of a steam vessel would affect injuriously the more delicate movement of the chronometer and taint the results must now fall to the ground. In the two voyages out and home of the *British Queen*, no derangement occurred, and the determination of the longitude of the far-distant ports she sailed between is, probably, settled for ever, within a fraction of a second of the truth."

APPOINTMENTS VACANT

Applications are invited for the following appointments on or before the dates mentioned:

Municipal Engineer to the Municipality of George Town, Penang,—Peirce and Williams, 1 Victoria Street, S.W.1 (November 7).

International Senior Fellowship in Science—The Hon. Secretary, British Federation of University Women, Ltd., 16 King Street, Reading, Berks (November 10).

Borough Electrical Engineer and Manager to the County Borough of Halifax—The Town Clerk, Town Hall, Halifax (November 14).

Research Professor of Medical Psychology in the University of Queensland—The Agent-General for Queensland, 409 Strand, W.C.2, or the Universities Bureau of the British Empire, 88a Gower Street, W.C.1.

Senior Technical Officers (Ref. 375/Y) and Technical Officers (Ref. 375/Z) by the Air Ministry—The Under-Secretary of State, S.2.A., Department Z.A., Air Ministry, Adastral House, Kingsway, W.C.2.

Part-time Lecturer in Physics—Head of the Department of Mathematics and Physics, The Polytechnic, Regent Street, W.1.

Temporary Meteorological Assistants (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B (Met.), Department Q.J., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Guide to the Collection of British Aculeate Hymenoptera. By Howard M. Hallett. Pp. 28. (Cardiff: National Museum of Wales.) 4*d*. [1110

London Shellac Research Bureau. Technical Paper No. 18: Fibrous Lac. By Dr. R. Bhattacharya and G. D. Heath. Pp. 14. (London: London Shellac Research Bureau.) [1210

Imperial Agricultural Bureaux. Herbage Publication Series, Bulletin 26: Research on Grassland, Forage Crops and the Conservation of Vegetation in the United States of America. Compiled by R. O. Whyte. Pp. 113. (Aberystwyth: Imperial Bureau of Pastures and Forage Crops.) 5*s*. [1310

Report of the Council of the Natural History Society of Northumberland, Durham and Newcastle-upon-Tyne, for the Year 1938-39. Pp. 44. (Newcastle-upon-Tyne: Hancock Museum.) [1610

Other Countries

Journal of the Indian Institute of Science. Vol. 22A, Part 12: The Stereo-Chemistry of Pinane and its Derivatives. By K. Ganapathi. Pp. 155–169. (Bangalore: Indian Institute of Science.) 1.3 rupees. [1110

Catalogue of Indian Insects. Part 24: Evanidæ. By M. S. Mani. Pp. ii+14+ii. (Delhi: Manager of Publications.) 7 annas; 8*d*. [1110

Imperial College of Tropical Agriculture. Eighth Annual Report on Cacao Research, 1938. Pp. 42+2 plates. (Port-of-Spain: Government Printing Office.) 5*s*. [1210

U.S. Department of Agriculture. Circular No. 523: Toxicity of Certain Organic Insecticides to Codling Moth Larvæ in Laboratory Tests. By E. H. Siegler, F. Munger and L. E. Smith. Pp. 10. (Washington, D.C.: Government Printing Office.) 5 cents. [1210

U.S. Department of the Interior: Office of Education. Bulletin, 1938, No. 17: Hospital Schools in the United States. By Cleie Lee Matheison. Pp. vii+79. (Washington, D.C.: Government Printing Office.) 15 cents. [1210

Smithsonian Institution: Bureau of American Ethnology. Bulletin 125: Ethnography of the Fox Indians. By William Jones. Edited by Margaret Welpley Fisher. Pp. ix+156. (Washington, D.C.: Government Printing Office.) 25 cents. [1210

Proceedings of the United States National Museum. Vol. 87, No. 3071: A New Trematode from the Loon, *Gavia immer*, and its Relationship to *Haematotrephus fodiens* Linton, 1928. By W. Carl Gower. Pp. 139–144. (Washington, D.C.: Government Printing Office.) [1310

Smithsonian Miscellaneous Collections. Vol. 98, No. 23: Stimulative Effect of Short Wave Lengths of the Ultraviolet on the Alga *Stichococcus bacillaris*. By Florence E. Meier. (Publication 3549.) Pp. ii+20+4 plates. (Washington, D.C.: Smithsonian Institution.) [1310

Trinidad and Tobago: Forest Department. Administration Report of the Conservator of Forests for the Year 1938. Pp. 16. (Trinidad: Government Printer.) 18 cents. [1310

Palæontologia Sinica. New Series C, No. 5 (Whole Series No. 114): The Fossils from Locality 12 of Choukoutien. By P. Teilhard de Chardin. Pp. ii+47+1 plate. (Nanking and Peking: Geological Survey Library.) [1610

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 127: Radio Research Board Report No. 14. Pp. 30. Bulletin No. 128: An Investigation of the Problems of Salt Accumulation on a Mallee Soil in the Murray Valley Irrigation Area. By J. E. Thomas. Pp. 88+2 plates. Pamphlet No. 88: The Oriental Peach Moth (*Cydia molesta* Busck) Investigations in the Goulburn Valley, Victoria; Progress Report for the Seasons 1935–38. By G. A. H. Helson. Pp. 23. (Melbourne: Government Printer.) [1610